TAKEOVER ANNOUNCEMENTS, INFORMATION ASYMMETRY, AND MARKET MICROSTRUCTURE: AN EMPIRICAL STUDY

By

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To my parents and my wife

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Uneven distribution of information not only hinders efficient discovery of prices, but also adversely affects other uninformed market participants. This research investigates if the specialists, uninformed of inside information, on the New York Stock Exchange have the ability to detect insider trading. In doing so, we test the validity of a microstructure theory as well as provide an empirival link between market microstructure and market efficiency.

Tests are conducted in two different ways. First, the behavior of bid-ask spreads net of holding costs is analyzed using regression analysis with the dummy variable. In the regression model, the intercept term represents the normal information costs and the dummy variable captures the change

in information costs. The results indicate that the specialists have the ability to detect insider trading. The comparison of "friendly" and "hostile" tender offers also presents confirming evidence. Our evidence is consistent with the hypothesis that the market is efficient, but the time lag before the detection suggests that it is not strongly efficient such that information is instantaneously reflected.

Second, we use the change in auto-correlation coefficients between the estimation and the test period. Theory suggests an increase in serial correlation as the proportion of the information cost component increases, i.e., if information trading is more prevalent and if the market maker detects the information arrival. The results are mixed. The Wilcoxon rank sum test shows no significant change in auto-correlation while the Wilcoxon sign test shows the opposite. In either case, caution should be taken because the estimation period is too short to be reliable.

The importance of the specialists in providing liquidity services for small firms is tested indirectly by comparing regression R^2's among different firm size groups. The results are basically consistent with the hypothesis in that the smallest firm size group exhibits the largest R^2 and it decreases as the firm size increases. The largest firm size group, however, shows abnormal behavior.

CHAPTER I
INTRODUCTION

Financial markets are considered fairly efficient in processing information, so that information, once publicly disseminated, is instantaneously reflected in prices. However, studies (e.g., Jaffee (1974)) provide evidence that insiders do possess superior information and can gain substantial profits by trading on their non-public information. Insiders profit at the expense of unsuspecting individuals.

One of market participants who can be the victim of uneven distribution of information is the specialist on the New York Stock Exchange. By having to stand ready to trade for his own account, the specialist is subject to heavy losses from trading with informed traders. Microstructure theory suggests that specialists faced with adverse selection problems increase the bid-ask spread to protect themselves from losses when increased information asymmetry is suspected. That is, when specialists expect greater losses to informed traders, they will widen the spread.

It follows that the specialists will expect a higher level of information asymmetry before firm-specific information events whose release has a significant impact on security price and is relatively easy to predict. This

implication was tested by Venkatesh and Chiang (1986) with earnings and dividend announcements as significant firm-specific information events. They found an increase in the level of information asymmetry before the second announcement, but not before the first nor joint announcements.

It is not clear in their study, however, whether the increase in information asymmetry before the second announcement is due to specialists' detection of insider trading or due to specialists' simply being suspicious of potential insider trading prior to a predictable event. The primary objective of this dissertation is to perform an unambiguous test of the ability of the specialists to detect the existence of insider trading. Ambiguity in the interpretation of the results of Venkatesh and Chiang is caused by the predictability of the event. Thus, an unambiguous test of the existence of insider trading requires a firm-specific event which is not predictable, but makes a good target for insider trading. Corporate takeover announcements satisfy both conditions. Takeover announcements are known to be associated with a large price increase and thus make a good target for insider trading. Further, studies on corporate takeovers uniformly report that substantial price increases are realized prior to the public announcement.

Some researchers (e.g., Keown and Pinkerton (1981)) consider the pre-announcement price increases as evidence of

information leakage due to insider trading. Jensen and Ruback (1983), however, warn that the above interpretation can be incorrect, stating that "the price adjustments prior to 'announcement day' are unbiased reponses to public information that increases the probability of a takeover" (p 14). Our study resolves this contrasting point of view by examining the effects of firm-specific information events on the behavior of the bid-ask spread. More specifically, we focus our attention on the behavior of a component of the spread that is attributable to information asymmetry. Bid-ask spreads are used instead of stock prices. The reason is that it is extremely difficult to test the two competing hypotheses on insider trading because noise can affect prices in a similar manner to information. Being a decision variable of the specialist, however, bid-ask spreads have little confounding effect. An increase in the information cost component of the spread is evidence of insider trading and the ability of the specialists to infer information regarding insider trading.

We investigate the specialists' ability to infer information using two different approaches. First, the behavior of bid-ask spreads net of holding costs will be examined. Any significant increase in the spreads before the announcement will lead us to conclude that the specialists are capable of detecting information trading.

The specialist's detection of this information has a market efficiency implication in the sense of Grossman

(1976) and Grossman and Stiglitz (1980). Market efficiency in Grossman is defined such that prices aggregating all the relevant information, including inside information, in turn reveal the information. Hence, by studying the behavior of the bid-ask spread, we provide not only a test of the validity of microstructure theory under asymmetric information, but an empirical link between market efficiency and market microstructure.

In the second approach, the auto-correlation coefficient in stock prices is used to examine the presence of information trading. Amihud and Mendelson (1980) show that, assuming no information trading, stock prices are negatively correlated because the specialist trying to avoid unwanted inventory holding risk induces an opposite transaction by adjusting bid or ask quotes. Glosten and Milgrom (1985) show transaction prices follow the random walk and hence zero serial correlation when information trading is prevalent. Hence, as the proportion of the information cost in the spread increases, i.e., as the level of information asymmetry increases, we would expect, ceteris paribus, serial correlation to become larger (i.e., moves from negative to zero).

Next, differential information contents of takeover techniques will be studied. The underlying impetus for this test is to see if the timing difference among different methods of takeover has any effect on the level of information trading. Further, an interesting feature about

corporate takeovers is that the condition of information asymmetry does not completely disappear even after the public announcement because of the potential failure of the takeover due to opposition from the target management. This possibility is tested by comparing the effect of "hostile" vs. "friendly" tender offers. Unlike conventional studies on differential information contests, which measures the effects of news releases on shareholders wealth, this research focuses on the effect of news on the welfare of the specialists.

Finally, the distinction between individual dealer spreads and the market spreads will be explored using samples of different firm sizes. Specifically, the hypothesis to be tested is that small firms will better reflect costs of specialists because spreads for small firms are more likely determined by specialists, whereas limit prices determine spreads for large firms.

In sum, by studying the behavior of bid-ask spreads around takeover announcements, this dissertation attempts to address the following questions: (1) How do specialists on the NYSE respond to the arrival of information? (2) Are their responses consistent with market efficiency? (3) Do unusual price and/or trading volume behavior signal to the specialist an impending information event? (4) Are specialists the dominant source of liquidity? (5) Do different methods of corporate takeovers have differential information contents?

The rest of the dissertation is organized as follows. Chapter II reviews the relevant literature. Data, hypotheses, and methodology are presented in Chapter III. Empirical results are presented and discussed in Chapter IV. In Chapter V, we provide the summary and conclusion.

CHAPTER II
LITERATURE REVIEW

Before microstructure analysis, classical price theory has assumed trading takes place in a Walrasian auction market where no frictions impede trading process. Resulting prices instantaneously equilibrate the demands and supplies of all traders. Actual securities markets, however, are characterized by non-synchronous arrival of buy and sell orders, which necessitates some institutional arrangements to help match buyers and sellers whose orders arrive at different times. Attempts to incorporate these institutional factors in the analysis of securities prices have led to the development of the new field in financial economics, the microstructure of securities markets. In sum, microstructure analysis is concerned with the interplay among market participants, trading mechanisms, and the dynamic behavior of security prices when trading is impeded by friction (i.e., information, decision, and transaction costs).

Major attention in the microstructure literature has been centered on the operations of market makers as suppliers of immediacy and their effect on the bid-ask spread and on transaction prices. This dissertation builds upon existing literature and its primary focus is on the

behavior of the bid-ask spreads around information announcements. Therefore,in this review we limit our attention to the bid-ask oriented literature.

Market Makers and the Bid-Ask Spread

One of the first studies of the transaction process in a financial market was by Stigler (1964). Stigler focused attention on the role of the specialist as a market maker. He showed how such a market maker, in his speculative trading, provides liquidity to the market. Stigler presents a simulation of transaction price movements generated by random tenders. Given a stationary equilibrium price, the transaction price bounces up and down along the demand curve with the random arrival of tenders. The fluctuations of transaction prices around an equilibrium price would present speculators with a profit opportunity. In so doing, these market participants provide resiliency to the market. Stigler also stated that the speculators would charge the cost of carrying inventories and of their personal services by the bid- ask spread they establish, and in competitive equilibrium, this spread would just cover the specialist's unit costs.

Stigler further suggested the existence of economies of scale in market making: "The greater the number of transactions in a security concentrated in one exchange, the smaller the discontinuities in trading.... As a result the

price of a security will almost invariably be 'made' in one exchange" (1964, p. 129).

Demsetz (1968) presents the first formal model of the bid-ask spread. Consistent with Stigler, he viewed the bid-ask spread as a return to the providers of immediacy and considered the time rate of transactions as the fundamental determinant of the size of the spread.

Figure 2-1 illustrates the basic model of Demsetz. D and S are demand and supply curves of the time rate of buy and sell orders for investors who place orders via market orders for immediate execution. E represents the conventional view of equilibrium price. However, there is no guarantee that buy and sell orders will reach the market simultaneously. Hence there exists a demand for a separate class of market participants who provide immediacy of transaction by standing ready to transact and assume inventories. To cover the cost of standing ready, they sell shares at a price slightly higher than E and buy at a price slightly lower than E. This results in D' and S' curves and there exists two equilibrium prices. The difference between A and B is the spread that is quoted. Demsetz takes this spread to be the gross return per unit to specialists for providing immediacy.

Demsetz also concludes, assuming potential waiting costs dominate security trading, that trading on the NYSE is subject to scale economies and thus the average spread for active securities will be smaller than that for inactive

securities. He also suggests a negative relationship between the time rate of transaction and the spread.

The analysis of Demsetz assumes the monopolistic market maker. Nevertheless, Demsetz recognized that sufficient competition from other providers of immediacy will equal the spread to the cost of providing immediacy. Competitive forces the specialist faces include "...(1) rivalry for the specialist's job, (2) competing markets, (3) outsiders who submit limit orders rather than market orders, (4) floor

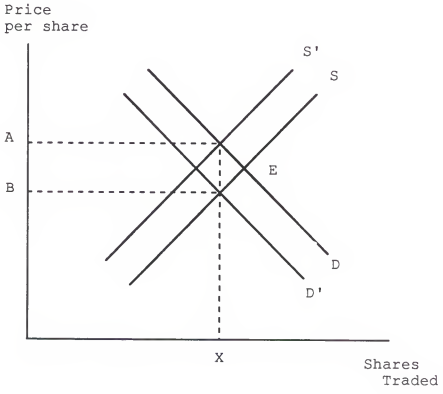

Figure 2-1

Diagramatic Illustration of the Demsetz Model

traders who may bypass the specialist by crossing buy and sell orders themselves, and (5) other specialists" (1968, p. 43).

Following Demsetz, Tinic (1972) and Tinic and West (1972) focus on the determinants of individual specialist spreads. Factors affecting specialist costs, they identify, include the level of trading activity in a security, share price volatility, and the number of issues handled by a specialist unit.

Subsequent studies, starting with Garman (1976) and Stoll (1978a), have built more rigorous models of dealer-specialist behavior. Since Demsetz, there have been two main lines of thought about the theory of the bid-ask spread. The first school focuses on the relationship between the bid-ask spread and dealer inventory costs. The second line of thought is based on the notion that the bid-ask spread can be a purely informational phenomenon which occurs even when the market maker's other transactions costs are zero.

Holding Costs

Stoll developed a supply-side model of the bid-ask spread. Consistent with Demsetz, he views dealers as providing the service of immediacy of trading and the spread as the return to the dealer for incurring costs in providing immediacy. He identifies the cost of providing immediacy as the sum of: (1) holding costs, (2) order costs and (3)

information costs. Order costs are the clerical costs of arranging trades, recording and clearing a transaction. Stoll borrows the idea of information costs from Bagehot (1971) and Jaffee and Winkler (1976). Information costs, according to them, arise because the dealer is committed to trade with anyone at prices which are unfavorable in light of the new information. This literature will be reviewed in more detail later.

Providing immediacy implies that the dealer has to move away from his desired portfolio and as a result assumes unnecessary risk. Holding costs in Stoll's model represent the price risk and opportunity costs of holding securities. The dealer will trade if the loss of utility from holding non-optimal portfolio is fully compensated such that expected utility of non-optimal portfolio plus compensation via spread equals expected utility of optimal portfolio.

Stoll made the following assumptions to develop the holding cost function: (1) dealer inventory positions, long or short, are financed solely at the risk free rate of interest; (2) the dealer acts as a passive price setter; (3) the dealer maximizes the expected utility of terminal wealth; (4) the dealer sets his bid and ask prices relative to his estimate of the "true" price; and (5) only one stock is traded per trading interval. Moreover, though not explicitly stated, Stoll assumes a single dealer or multiple dealers with no interaction among themselves. Under these assumptions, Stoll shows that the holding cost component of

the spread depends on: (1)dealer characteristics--relative risk aversion and initial wealth; (2) the transaction size; and (3) characteristics of the stock--variance of return. Note that the spread is independent of the initial inventory of the dealer. It is because bid and ask prices move together in the same direction when there exists a pressure for inventory rebalancing.

His model also yields an optimal inventory position for each dealer in a security and for a security, an optimal number of dealers.

Ho and Stoll (1981) extend the Stoll's model by introducing the stochastic demand (modeled by a continuous time Poisson jump process) and transactions uncertainty, which is uncertainty about when future transactions will occur. Their model yields basically the same results as the Stoll's. That is, the spread is dependent upon the fundamental characteristics of the dealer and stock which are relatively stationary over time: transaction size, the return variance of the stock and the dealer's attitude toward risk. Consistent with Stoll, the spread does not depend on the dealer's inventory position. However, dealer price adjustment does depend on inventory. Transactions uncertainty is not undesirable per se because there is no direct adverse effect of a below average number of buyers or sellers. It is undesirable only because it increases the uncertainty of the return on the dealer's portfolio by

making uncertain how large an unbalanced position must be held.

Following Garman, Amihud and Mendelson (1980) derive the optimal pricing policy of a price-setting monopolistic market maker in a dealership market where the stochastic demand and supply are generated by Poisson processes. The dealer in their model maximizes the expected average profit per unit time. Consistent with the dynamic pricing described by Smidt (1971) and Barnea (1974), the optimal bid and ask prices are monotone decreasing functions of the stock at hand. Furthermore, unlike Stoll and Ho and Stoll, the bid-ask spread depends on the level of the dealer inventory because the dealer reduces the spread as he approaches the preferred inventory level.

Information Costs

Bagehot (1971) was the first to suggest that the market maker is faced with basically two types of traders: traders possessing inside information and liquidity-motivated traders who have no special information. The market maker always loses to informed traders since this group of traders have the option not to trade. That is, informationally motivated traders will buy (sell) based on their non-public information if and only if the price given new information is greater (smaller) than the ask (bid) price. This is a classic example of an adverse selection problem. Market failure in the sense of Akerlof (1970), however, is

prevented as long as the spreads are not set prohibitively large because liquidity-motivated traders, by definition, are willing to pay the price for immediacy of trading. In other words, if the security demand is relatively inelastic the risk of market failure is reduced.

The bid-ask spread is determined so that the gain from the liquidity-motivated traders fully offsets the loss to the information-motivated traders.

The intuition of Bagehot is formalized by subsequent works of Copeland and Galai (1983) and Glosten and Milgrom (1985). Copeland and Galai assume a risk-neutral dealer in an anonymous market with a quote limited to a fixed number of shares. Anonymity of asset markets is a sufficient condition for information to have private value. Being a risk-neutral dealer, his objective is to choose the bid-ask spread that maximizes the expected profit which is the expected revenue from the liquidity traders minus the expected loss to the informed traders. The dealer's expected costs depend on "the probability that the next trader is informed, the dealer's knowledge of the stochastic process governing price changes, and his choice of bid and ask prices" (1983, p 1460). Thus, one would expect an increase in the bid-ask spread as greater percentage of traders are informed. They further predict a negative relationship between the bid-ask spread and trading volume when the size of the transaction is held constant and a

positive relationship when the number of transactions is held constant.

Copeland and Galai further present a unique way of looking at the spread as "a free straddle option." A prospective trader is given, free of charge, a call option to buy a security at the ask price and also a put option to sell at the bid price. To liquidity-motivated traders, both options are in the out-of-the-money position. The loss incurred when an uninformed trader exercises an out-of-the-money option represents the price he is willing to pay for immediacy. The option pricing theory predicts that the resulting spread depends on the security price as well as on the variance of security prices.

Glosten and Milgrom (1985) also formally analyzed the determinants of the magnitude of the spread. But their emphasis lies in the examination of the dynamic properties of the spread and transactions prices. In particular, they are interested in how private information is processed by the specialist.

Whereas Copeland and Galai assume that private information is revealed immediately after each trade, Glosten and Milgrom allow further trading until there is no longer an informational gap between the informed and the rest of the market. In this way, the dynamic properties of transaction prices and the spread could be analyzed.

They found that in general, "ask prices increase and bid prices decrease if the insiders' information becomes

better, or the insiders become more numerous relative to liquidity traders,or the elasticity of th expected supply and demand of a liquidity trader increases" (1983, p 74). Moreover, their model predicts the transaction prices are informative, and thus spreads tend to decline with trade.

Another interesting result is that the transaction prices form a martingale, which implies no serial correlation in the transaction prices. This result contradicts the idea that the existence of spreads results in the negative serial correlation in stock prices which is empirically observed. One implication is that different sources of the spread affect the properties of the transaction price process differently. The same conclusion was drawn by Glosten (1987). In light of this result, Glosten and Milgrom suggest the serial correlation coefficient of price changes can be used to determine the relative magnitudes of these two sources of the spread.

The Market Spread

The most common approach in the literature has been to depict the market maker (1) as a competitive dealer but ignore the interaction of his quotes with other dealers' quotes (e.g., Stoll (1978a), Copeland and Galai (1983) and Glosten and Milgrom (1985)) or (2) as a monopolist dealer through whom all trades must be executed (e.g., Garman (1976) and Amihud and Mendelson (1980)). In the first case, the competitive forces work to remove the monopoly rents so

that the expected profit of the market maker is zero. In all cases, it is assumed that individuals place with the market maker only market orders.

What is largely neglected in the literature is that ordinary traders also provide immediacy via their limit orders. As a result, the observed bid-ask spread (the market or inside spread), which is the transaction cost ordinary traders must incur, is determined by the difference between the lowest ask and the highest bid across all limit orders including the market maker's quotes. It may be that the market maker's bid (ask) price is lower (higher) than the highest (lowest) limit buy (sell) order. Thus, one would expect that in general, the market spread will be smaller than the spread of any individual market maker. And the observed spread may not fully reflect the individual specialist's costs. Nonetheless, with the notable exceptions of Cohen, Maier, Schwartz and Whitcomb (1981, CMSW henceforth) and Ho and Stoll (1980, 1983), no attempt has been made to model the size of the market bid-ask spread in the dynamic, interactive context that characterizes actual security markets.

Empirical studies have been no exception in this regard. Empirical works of Demsetz (1968), Tinic (1972), and Benston and Hagerman (1974), to name only a few, failed to distinguish between the market spread and the spread of an individual market maker. Hamilton (1978) and Stoll (1978b) are among the few who explicitly recognized and

avoided the inherent problem by using the average spreads of individual dealers.

Very interestingly, however, Hamilton (1978) showed that regression results using the market spreads are not distinctively different from those obtained by using the average spreads. The overall goodness of fit, as represented by the R^2's, is virtually identical for both regressions and the individual independent variables generally have the correct sign and are significant.

Ho and Stoll (1983) developed a theoretical model of equilibrium bid and ask quotes and equilibrium spreads in a market with competing dealers facing price and transaction uncertainty. In their model the market spread is set by the dealer with the second lowest reservation fee, which depends on the dealer's risk aversion, the stock's risk, and the transaction size. It is because the dealer with the lowest reservation fee has no incentive to quote that fee. He will instead quote his nearest competitor's reservation fee. They further showed under the assumptions of homogeneous preferences and opinions that as a public sell (buy) order will be handled by the dealer with the smaller (bigger) inventory, inventory differences among dealers will be narrowed and the reservation fee of each dealer will be identical. As a result, the market spread equals the reservation fee of any dealer. This result can provide an explanation of Hamilton's (1978) findings that the market

spreads yield almost identical regression results to the average spreads.

Whereas Ho and Stoll base their model on the dealer costs, CMSW (1981) suggest that the market spread will naturally exist, even when there is no market maker, if traders are permitted to submit limit orders. They argue that the probability of execution of the limit order decreases rapidly in a neighborhood just to the left of the market ask price. Thus, as the potential limit price rises toward the market ask, it becomes relatively more attractive to transact at the market ask with certainty. In other words, certainty of execution at the market ask causes investors to jump their price once their potential limit bid gets close enough to the market ask. This clears out limit bids which are too close to the market ask, thereby leaving a nonzero spread.

The probability of a limit order executing decreases as a security's order arrival rate decreases. Thus, ceteris paribus, thin issues have a lower probability of limit orders executing than do thick issues. This lower probability in turn decreases the proportion of investors choosing limit orders over market orders at any given size of the spread. This implies that, for a thinner issue, a wider spread would be required for the forces that increase and decrease the spread to be in equilibrium.

Autocorrelation of Security Returns

Market efficiency, in combination with the assumption that equilibrium expected returns are constant through time, implies that securities prices follow the random walk, i.e., the autocorrelations of the returns on any security are zero for all values of the lag. Empirical studies, however, have documented "weak serial correlation in individual securities' daily returns, with the proportion of securities yielding significant autocorrelations decreasing as the returns measurement interval increases, and with predominantly negative sign for thin securities and positive sign for thick securities" (Cohen et al. (CHMSW) (1980), p 250).

Microstructure approach to explaining this phenomenon has been based upon the recognition that transaction prices differ from "true" asset value in a frictionless environment. Goldman and Beja (1979) argue that due to structural imperfections such as technical limitations in order processing and costs associated with the placing of limit orders, the price adjustment is not instantaneous. As a result, prices depend not only on the current attributes of the environment but also on previous prices. Other examples of price adjustment lags are given in Goldman and Sosin (1979) and CMSW (1979). Goldman and Sosin show that given transaction costs, the optimal behavior is the periodic review of accumulated information rather than continuous assessment of each "news bit" as it arrives.

Further, CMSW have shown, given assessments of information, that a do-nothing strategy may be optimal even if a trade is sought. Hence, new orders transmitted to the market in part reflect the impact of old information.

Scholes and Williams (1977) also demonstrate returns are serially correlated even though the underlying return generating process is random. They suggest, as in Fisher (1966), that since quotes can be updated without an accompanying transaction, the closing transaction prices typically reflect out-of-date information. This price adjustment delay causes serial correlation in security prices.

Garman (1976), on the other hand, suggests that the serial dependence of security returns is attributable to the structure of the double-auction market itself rather than the market maker's intervention.

Goldman and Beja postulate two sources of variability; one from fluctuations of the underlying value of the asset and the other from those in the market mechanism. From the time-variance relationship, the sign of the serial correlation depends on the relative magnitude of the two sources of variability. If the specialist reduces the second source of variance, while performing his function to maintain an orderly market, below the first one without a proportional reduction in the average convergeance rate of transaction prices, his actions will introduce a positive serial correlation in security returns. If his action

affects both variance and the convergeance rate, the specialist's interference will result in negative autocorrelation. Positive auto-correlation in this situation means the specialist's over-interference.

Delays in updating limit orders on the book can lead to positive serial correlation as those traders who respond quickly enough to new information have an opportunity to hit orders that have not yet been revised (CHMSW (1980)). Schwartz and Whitcomb (1976) suggest that the limit on the size of permissible price changes on the NYSE can cause a negative serial correlation.

Ho and Stoll (1981) and Amihud and Mendelson (1980) show that the market maker's quotes will depend on his inventory position. The reason is that the dealer wishes to return to his optimal portfolio to avoid inventory holding costs. When the dealer holds a positive inventory, he will lower both his buy and sell prices in order to induce public buy order arrival and reduce the probability of public sell order arrival. Conversely, when the dealer holds a negative inventory, he will raise both his buy sell prices and thus encourage public sell order arrival and discourage public buy order arrival. In this environment the coefficient of auto-correlation has a negative sign. Ho and Macris (1984), in their empirical study of some AMEX options, confirm the prediction by reporting predominantly negative auto-correlation in option returns.

While spreads due to holding costs lead to negative auto-correlation, Glosten and Milgrom (1985) demonstrate that spreads due to information asymmetry cause zero serial correlation. In their model, expectations are revised upward in response to specialist sales and downward in response to purchases. That is, if a trade takes place at the bid price, then the transaction price is the bid price which reflects the revised expectation. Proposition 2 of Glosten and Milgrom states that "the sequence of transaction prices forms a martingale ..." (1985, p. 82), which means no serial correlation in transaction returns. It follows that when there exists no source of serial correlation other than the holding cost component and the information cost component of the spread, their model implies the correlation coefficient moves toward zero if the proportion of the spread due to adverse selection increases.

Summary

The bid-ask spread is comprised of three different costs arising from providing immediacy of transaction: (1) order costs, (2) holding costs, and (3) information costs. Order costs are fixed, clerical costs. Inventory holding costs include price risk and opportunity costs due to holding non-optimal portfolio. Factors affecting the second component of the spread include: (1) an activity variable such as volume of trading, (2) a risk variable such as variance of return of the stock, and (3) a measure of

competition such as the number of competing markets. Information costs arise because some investors have superior information which can lead to a significant change in security price when announced.

Because of the limit orders placed by individual investors, the observed market spread will in general be less than the spread of an individual market maker and so may not fully reflect the market maker's costs. This will be particularly true for active issues.

The intervention of the market maker causes a serial correlation in securities prices. However, the information cost component induces zero serial correlation while the holding cost component of the spread causes a negative serial correlation.

CHAPTER III
RESEARCH DESIGN

Data

Sample firms are selected from the CRSP Daily Stock Master File from firms which are merged or bought out during the period between 1983 to 1986. The event date is the first public announcement date of the takeover and is verified from the Wall Street Journal Index. Firms whose announcement dates of takeover are not easily identified[1] are discarded from the sample. Also discarded from the sample are those firms which are not listed on the New York Stock Exchange nor included in the Francis Emory Fitch publications. Firms which have undergone stock splits or paid large stock dividends during the investigation period are also eliminated[2].

Closing bid and ask quotes of each stock are collected from the Francis Emory Fitch publications. The daily trading volume data are collected from the NYSE Daily Stock Prices. The CRSP Daily Return File provides daily stock returns data.

Sample Characteristics

The final sample includes 146 takeover target firms[3] listed on the New York Stock Exchange, of which there are 61

mergers, 61 tender offers and 24 leveraged buy-outs (LBO's). Tender offers are subdivided into "friendly" and "hostile" tender offers[4], each type of which accounts for about half of the tender offer sample. The distribution of takeover announcements can be seen in Table 3-1. Notice that mergers were the major takeover technique until 1984, but tender offers became the dominant method of takeover from 1985.

Table 3-1
Distribution of the Sample By Year and Takeover Type

	YEAR				
TYPE	1983	1984	1985	1986	TOTAL
Merger	13	18	19	11	61
Tender Offer	5	9	25	22	61
LBO	4	11	9	-	24
TOTAL	22	38	53	33	146

The microstructure literature (e.g., see Stoll (1978b)) reports a negative relationship between the bid-ask spread and thinness of trading. The reciprocal of firm size, as measured by the reciprocal of firm capitalization, is often used as a measure of thinness. In Table 3-2, we present a grouping of the sample by firm size. The sample is arbitrarily divided in five groups of equal number where size I is the smallest while size V is the largest. Consistent with other studies, the sample shows a clearly

Table 3-2

Summary Statistics By Firm Size:
Base Period versus Test Period[a]

A. Base Period

Group	N	Variable[b]	Minimum	Maximum	Mean	Std.Dev.
		Spread[c]	0.94	3.56	1.80	0.74
Size		Volume	9.00	1337.00	127.62	234.91
I	29	Price	4.56	35.00	18.38	9.81
		Variance[d]	0.62	64.47	6.28	9.62
		Size	2.74	122.17	74.35	33.49
		Spread	0.52	1.82	1.25	0.32
Size		Volume	31.00	1004.00	219.66	201.15
II	29	Price	12.13	46.95	25.08	9.52
		Variance	0.31	8.75	4.21	2.54
		Size	123.15	241.27	177.70	37.30
		Spread	0.61	1.92	1.17	0.31
Size		Volume	54.00	866.00	372.03	229.07
III	30	Price	11.42	46.72	23.76	8.91
		Variance	0.94	9.24	4.27	2.09
		Size	243.17	422.77	321.84	56.13
		Spread	0.50	1.72	0.96	0.28
Size		Volume	235.00	1270.00	593.28	337.69
IV	29	Price	13.39	50.65	29.96	11.00
		Variance	0.70	7.49	3.30	1.87
		Size	432.76	781.25	582.57	98.00
		Spread	0.37	1.31	0.67	0.23
Size		Volume	48.00	5359.00	1704.69	1128.91
V	29	Price	15.66	73.40	39.00	14.44
		Variance	1.06	15.54	3.53	2.84
		Size	784.18	13058.04	2412.07	2376.54
		Spread	0.37	3.56	1.17	0.56
Total		Volume	9.00	5359.00	601.87	797.48
	146	Price	4.56	73.40	27.21	12.80
		Variance	0.31	54.47	4.31	4.83
		Size	2.74	13058.04	711.02	1358.28

Table 3-2--Continued

B. Test Period

Group	N	Variable	Minimum	Maximum	Mean	Std.Dev.
		Spread	0.93	4.04	1.70	0.78
Size		Volume	8.00	998.00	182.72	242.54
I	29	Price	4.04	37.48	19.73	10.28
		Variance	0.38	56.41	8.47	11.12
		Size	2.74	122.17	74.35	33.49
		Spread	0.45	1.68	1.09	0.32
Size		Volume	45.00	1671.00	427.21	478.79
II	29	Price	12.57	61.88	28.31	12.34
		Variance	1.49	20.45	6.46	4.75
		Size	123.15	241.27	177.70	37.39
		Spread	0.52	2.02	1.11	0.41
Size		Volume	109.00	2957.00	603.37	536.77
III	30	Price	10.68	68.81	26.94	13.42
		Variance	0.33	29.94	6.62	6.13
		Size	243.17	422.77	321.84	56.13
		Spread	0.42	1.97	0.91	0.34
Size		Volume	142.00	2921.00	866.79	671.95
IV	29	Price	12.30	53.07	32.45	11.85
		Variance	0.95	23.69	6.23	5.36
		Size	432.76	781.25	582.57	98.00
		Spread	0.31	1.35	0.62	0.26
Size		Volume	103.00	6290.00	2488.90	1789.83
V	29	Price	16.22	82.32	42.49	16.81
		Variance	0.79	31.29	6.30	6.36
		Size	784.18	13058.04	2412.07	2376.54
		Spread	0.31	4.04	1.09	0.58
Total		Volume	8.00	6290.00	911.67	1220.59
	146	Price	4.04	82.32	29.96	14.95
		Variance	0.33	56.41	6.81	7.06
		Size	2.74	13058.04	711.02	1358.28

[a]The base period constitutes 80 trading days which are not contaminated by the information, while the test period consists of 21 trading days just prior to the first public announcement of the event.

[b]Values of the variables are the cross-sectional averages of each firm's time-series averages for 80 days.

[c]Spread = 100*(Ask - Bid)/Price

[d]Variance is calculated using percentage daily returns, i.e., daily returns multiplied by 100.

negative relationship between the firm size and the proportional spread. Trading volume increases as the firm size gets larger, which confirms the reliability of firm size as a measure of thinness of trading. Note the average price also goes up with the firm size while average price variance shows the opposite behavior.

Bid-ask spreads in all size groups decrease in the test period. The decline of the average proportional spread is about seven per cent. Also consistent with the findings of takeover studies, trading volume, stock price, and price variance are shown to increase by about 51 per cent, 10 per cent, and 58 per cent respectively in the test period. Greater trading volume and higher stock price work to reduce the size of the spread whereas an increase in price variance contributes to its increase. It follows that smaller spreads in the test period may have resulted from the impact of the former on the size of the spread outweighing that of the latter.

Table 3-3 presents summary statistics of the sample data according to the takeover technique over the base and test periods. It shows target firms in tender offers were on average larger in size than those in mergers and LBO's. Average percentage spread of merger firms is 1.31 percent, which is much larger than that of tender offer and LBO firms. The difference between mergers and tender offers may be explained by the big difference in average trading

Table 3-3

Summary Statistics by Takeover Type:
Base Period versus Test Period*

A. Base period

Group	N	Variable	Minimum	Maximum	Mean	Std.Dev.
Tender Offer	61	Spread	0.37	3.44	1.06	0.53
		Volume	20.00	5359.00	819.30	937.39
		Price	6.57	73.40	31.00	14.27
		Variance	0.89	15.55	4.12	2.76
		Size	35.45	13058.04	1022.34	1854.05
Merger	61	Spread	0.45	3.56	1.31	0.62
		Volume	9.00	3933.00	462.62	702.35
		Price	4.56	63.82	23.64	11.18
		Variance	0.62	54.46	4.80	6.84
		Size	2.74	4472.61	522.26	866.33
LBO	24	Spread	0.48	1.81	1.09	0.36
		Volume	31.00	1775.00	403.17	383.16
		Price	11.42	47.81	26.67	10.16
		Variance	0.31	6.93	3.58	1.96
		Size	127.89	1096.27	399.53	263.49

B. Test Period

Tender Offer	61	SPREAD	0.31	2.27	0.91	0.42
		VOL	23.00	6290.00	1424.43	1468.21
		PRICE	7.62	82.32	34.26	16.24
		VAR2	1.18	31.29	7.28	6.29
		SIZE	35.45	13058.04	1022.34	1869.30
Merger	61	SPREAD	0.39	4.04	1.28	0.70
		VOL	8.00	6020.00	552.00	922.22
		PRICE	4.04	68.81	26.33	14.15
		VAR2	0.33	56.41	6.84	8.54
		SIZE	2.74	4472.61	522.26	873.45
LBO	24	SPREAD	0.44	2.02	1.05	0.42
		VOL	45.00	2993.00	522.58	593.35
		PRICE	10.68	48.17	28.26	10.51
		VAR2	1.47	13.41	5.55	4.26
		SIZE	127.89	1096.27	399.53	269.10

*The definition of the periods and the variables is the same as in Table 3-2.

volumes and average prices between merger and tender samples. Considering smaller average trading volume of LBO's, however, the smaller average percentage spread of LBO's is puzzling. An explanation to this phenomenon may be given by extreme values in the merger sample as can be seen in the minimum price of $4.56 and the maximum spread of 3.56 percent compared to $11.42 and 1.81 percent of the LBO sample. Given the equal weight of each firm in calculating the averages, extreme values can have a stronger effect on the average. The slightly higher average price of LBO's also contributes to the smaller spread.

All types show an increase in trading volumes and prices and a decrease in average spreads in the test period, while the change is most pronounced in tender offers. The trading volume has risen by 74 per cent in tender offers whereas mergers and LBO's have experienced 19 and 30 per cent respectively. Despite the increase of trading volumes and prices, the average spreads in mergers and LBO's show a decrease of meager 2.3 and 3.7 per cent while tender offers report a 14 per cent decrease. This might have some implications for difference in information costs among takeover methods and will be further explored later.

Hypotheses

In their survey of the literature on corporate control contests, Jensen and Ruback (1983) summarize the returns to target firms in the takeover contests as follows:

> "...targets of successful tender offers and mergers earn significantly positive abnormal returns on announcement of the offers... . Targets of unsuccessful tender offers earn significantly positive abnormal returns on the offer announcement and through the realization of failure. However, those targets that do receive additional offers in the next two years lose all previous announcement gains... targets of unsuccessful mergers appear to lose all positive returns ... by the time failure of the offer becomes known." (1983, p 15).

It is also noted that almost half of the abnormal returns associated with takeovers occur prior to the public announcement. Some studies (e.g., Keown and Pinkerton (1981)) attribute this to information leakage from insider trading[5]

Being subject to heavy loss from trading with informed traders, the specialist has a strong incentive to closely monitor the price movements and the trading activities such as the transaction frequency and volume. Thus, the market maker may develop prior notions about the statistical distribution of the normal level of price changes and the trading size and frequency. To the extent that information trading alters the trading frequency and/or size, the market maker will be alerted to the potential arrival of significant information. As the specialist suspects the arrival of new information, he will widen the bid-ask spread to protect himself from loss. Note that the spread increase before the takeover announcement not only reflects the specialist's ability to infer the information, but has a market efficiency implication. When insiders trade, they trade off for profits the probability of revealing their

non-public information. Therefore, any detection of this information without identifying the insiders amounts to evidence of market efficiency in the sense of Grossman (1976) and Grossman and Stiglitz (1980). The first hypothesis to be tested is:

Hypothesis 1: The bid-ask spread will widen before the announcement of the corporate takeover.

As discussed in Chapter II, Glosten and Milgrom (1985) have shown that the spread due to information asymmetry has a different effect on the dynamic properties of stock prices from that due to holding costs. In their model, specialist sales and purchases are associated with expectations revised downward and upward respectively. Then the transaction prices are true prices reflecting revised expectations. Accordingly, transaction prices follow the random walk.

Their model predicts that as the proportion of the spread due to adverse selection increases, the serial correlation of stock prices moves from negative toward zero. However, since the serial correlation of stock returns also depends on other forms of price adjustment delays, the sign of the auto-correlation coefficient can not be known a priori. Yet, ceteris paribus, the auto-correlation coefficient will be larger as the information asymmetry increases. Hence we test the following hypothesis as an alternative test to Hypothesis 1:

Hypothesis 2: Auto-correlation coefficients will increase before the takeover announcement.

One interesting feature associated with mergers and tender offers is that uncertainty regarding the ultimate consummation of the takeover is not resolved even after the public announcement. Since target managers replaced after takeovers lose all the benefits as well as the value of organization-specific human capital, they have incentives to oppose a takeover bid even if shareholders might benefit substantially from acquisition. Define a tender offer "friendly" if the target management does not oppose a bid and "hostile" otherwise. Then, in case the tender offer is hostile, another form of information asymmetry will be introduced at and after the announcement. The target management has the sole knowledge of whether or not to oppose the bid. As a result, a new form of information asymmetry develops between the target menagement and the market maker.

It follows that the degree of information asymmetry will be reduced after the announcement only if the takeover is characterized as friendly at the announcement. A large degree of information asymmetry will remain even after the announcement for hostile takeovers. This suggests the following hypotheses:

Hypothesis 3A: The bid-ask spread of takeover target firms should be reduced immediately after the friendly nature of the takeover becomes known to public while that of hostile takeover target firms may not.

Hypothesis 3B: There is no difference in the size of the spread between friendly and hostile takeovers before the announcement.

The next hypothesis is about a comparison of differential information effects of different techniques of takeovers. Mergers generally involve three steps: (1) negotiation with target managers, (2) approval by the board of directors, and (3) approval by target share-holders. Compared to mergers, tender offers take less time to complete as they are made directly to target shareholders who decide individually whether to tender their shares for sale to the bidding firm. As mergers tend to be a more lengthy process, there exists a greater probability for insider trading to begin long before the announcement and for more insiders to transact for profits. Hence, we have the following hypothesis:

Hypothesis 4: The increase of the bid-ask spread, if any, of mergers is greater and be realized earlier than that of tender offers.

The report of the Special Study of Security Markets reveals that the percentage of market transactions in which the specialist participated is inversely related to trading volume[6] (see Appendix B). This implies that for actively traded stocks, it is more likely that market orders are met by the limit orders placed by individual traders. Since it has been shown that firm size and thinness of trading are highly negatively correlated, one would expect the

probability of the specialist being the dominant provider of immediacy will be greater for small firms. Further, it is more likely the observed market spread is determined either on one or both sides by the limit prices on the specialist's limit book.

When the market spread is determined by the limit orders placed by individual traders, the observed spread will contain little information about the specialist's risk assumption. That is, although the spread has to cover the costs of the specialist on average, the individual spread on any day might not fully reflect these costs as CMSW (1981) suggest. We thus have the following hypothesis:

Hypothesis 5: Specialists play a more significant role in providing immediacy of transaction for small firms than large firms. As a result, the spreads may not fully reflect the costs specialists incur for large firms.

Methodology

We first present the standard event study technique employed to examine the time-series behavior of bid-ask spreads and trading volumes for evidence of any acquisition-related effects. Next, we introduce the empirical model that will be used to test hypotheses developed earlier. After that hypotheses are restated in testable forms and detailed methodology to test each hypothesis is provided.

Event Study Methodology

Event study methodology is a well established technique in finance to assess the effect of specific corporate announcements on security prices. Among several variations of the technique, we employ the "Comparison Period Return" approach of Masulis (1980). We assume the stochastic processes generating proportional bid-ask spreads and daily trading volumes are

$$\tilde{S}_{it} = \mu(s)_i + \tilde{u}_{it}$$

and

$$\tilde{V}_{it} = \mu(v)_i + \tilde{\epsilon}_{it},$$

where

$\mu(s)_i$ and $\mu(v)_i$ are the non-stochastic means of percentage deviation of spreads ($\tilde{S}_{it}$) and volumes ($\tilde{V}_{it}$) respectively, and

$$\tilde{s}_{it} = \frac{\tilde{S}_{it} - \bar{S}_i}{\bar{S}_i} ,$$

$$\tilde{v}_{it} = \frac{\tilde{V}_{it} - \bar{V}_i}{\bar{V}_i} ,$$

where

$$\tilde{S}_{it} = \frac{Ask_{it} - Bid_{it}}{(Ask_{it} + Bid_{it})/2}$$

$\bar{S}_i$ = the mean of $\tilde{S}_{it}$,

$\tilde{V}_{it}$, $\bar{V}_i$ = daily trading volume of firm i and its mean.

$E(\tilde{\epsilon}_{it})=0$, $E(\tilde{u}_{it})=0$, $cov(\tilde{\epsilon}_{it},\tilde{\epsilon}_{it-1})=0$, and $cov(\tilde{u}_{it},\tilde{u}_{it-1})=0$ for all i and t.

The percentage deviation of spreads and daily volume of trading is used for cross-sectional comparison.

Estimates of $\mu(s)_{it}$ and $\mu(v)_{it}$ are obtained from a time series of bid-ask spreads and daily trading volumes over what we call the estimation period. To avoid contamination by the information as much as possible, the estimation period includes 80 trading days which in general start backward from one month before the test period. The test period consists of 21 trading days just before the first public announcement date, the announcement date and seven trading days following the announcement. This time framework is depicted in Figure 3-1.

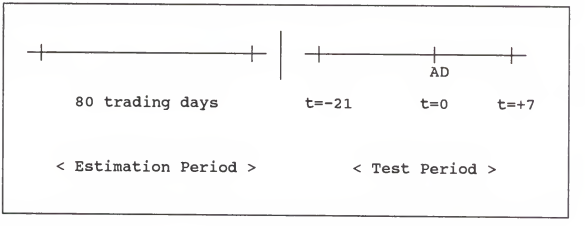

Figure 3-1
Event Time Frame

Abnormal bid-ask spreads and trading volumes are then calculated as follows:

$$\tilde{\delta}_{it} = \tilde{S}_{it} - \hat{\mu}(s)_i$$

and

$$\tilde{e}_{it} = \tilde{V}_{it} - \hat{\mu}(v)_i,$$

where $\tilde{\delta}_{it}$ and $\tilde{e}_{it}$ are abnormal spread and abnormal trading volume for firm i on day t respectively, and $\hat{\mu}(s)_i$ and $\hat{\mu}(v)_i$ are arithmetic means of bid-ask spreads and trading volumes during the estimation period and are estimates of true means.

Once the abnormal spread and volume for each firm is determined for each day during the test period, $\tilde{\delta}_{it}$ and $\tilde{e}_{it}$ are cross-sectionally averaged to yield average abnormal spreads and trading volumes for each day:

$$AR(s)_t = \frac{1}{n_t} \sum_i \tilde{\delta}_{it}, \quad i=1 \text{ to } 146, \text{ and}$$

$$AR(v)_t = \frac{1}{n_t} \sum_i \tilde{e}_{it}, \quad i=1 \text{ to } 146,$$

where $AR(s)_t$ and $AR(v)_t$ are the average abnormal spread and trading volume on day t respectively, and n_t is the sample population on day t.

The hypothesis to be tested has the following two-tail test form:

H_0: $AR(s)_t = 0$ and $AR(v)_t = 0$

No significant change in the bid-ask spread and daily trading volume is observed in the test period.

H_1: $AR(s)_t$ NE 0 and $AR(v)_t$ NE 0

Bid-ask spreads or daily trading volume have changed before the public announcement of takeovers.

NE stands for 'not equal to.'

Empirical Model

The empirical model employed to test hypotheses in this dissertation is basically borrowed from Stoll (1978a) and Ho and Stoll (1981), and similar to that used in Venkatesh and Chiang (1986). In Stoll and Ho and Stoll, the holding cost component depends on the fundamental characteristics of the stock and the dealer: the dealer's relative risk aversion and equity, the transaction size, the holding period and the variance of return of the stock. The dealer characteristics are relatively stable over time and unlikely to change over a short span of time. Thus, they will not play a major role in this study.

The empirical model to be used has the log-linear form:

$$Spread_t = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln VOL_t + \beta_3 \ln VAR_t + \beta_4 D_t * \ln VOL_t + \beta_5 D_t + \epsilon_t \quad (1)$$

where $D_t = 1$ if t is a day in the test period,

$= 0$ otherwise

To draw cross-sectional inferences, we pool the cross-sectional and time-series data and estimate a single equation.

Note that in our specification of the empirical model the intercept term, β_0, is interpreted as the normal information costs. An increase in the level of information asymmetry during the test period should be reflected in an upward shift of the intercept. The dummy variable, D_t, thus captures the change in the information costs.

The dependent variable, $Spread_t$, is the log of the proportional spread defined as

$$Spread_t = \ln \frac{A_t - B_t}{(A_t + B_t)/2} \times 100$$

where A_t and B_t are closing ask and bid quotes on day t respectively.

P_t is the average of closing bid and ask prices on day t. The average price is use instead of the closing transaction price in order to avoid any problem that might arise due to the type of the information lag between the closing bid-ask spreads and the closing prices as discussed in Fisher (1966) and Scholes and Williams (1977)

The price variable captures the effect of the fixed costs. As the fixed dollar amount is spread over for prices, one would expect a negative sign on P_t. Stoll (1978b) suggests price might explain some of the risk not reflected in return variance.

The holding period of the specialist is not directly observable and is assumed to be a function of trading volume in the stock. This is not an unreasonable assumption

because it is easier for the specialist to reverse his position when trading is active. The daily trading volume on day t, VOL_t, is used as an explanatory variable.

Studies show a significant increase in trading volume before takeover announcements. Because of the discreteness of the spread adjustment and also of the minimum allowable spread of 1/8 dollar, when trading volume is sufficiently large, the true spread will be less than or equal to the quoted spread. To capture this effect, an interaction term, $D_t*\ln VOL_t$, is included. A positive sign for the variable is expected.

It was suggested that information trading may alter the trading pattern. Hence the likelihood of adverse information may be a function of the transaction size which will be reflected in daily trading volume. When the specialist sees unexpectedly high volume, he will revise upward his estimate of the probability of insider activity and increase the spread accordingly. This argument suggests a positive relationship between the spread and volume. Thus, the change in the degree of information asymmetry around the information announcement is partly captured by the interaction term, $D_t*\ln VOL_t$. Therefore, we would expect the sign of the interaction term to be positive.

Since the specialist is forced to hold less than fully diversified portfolio, the appropriated measure of risk he faces is firm specific risk, not just systematic risk. The variance rate of return is used as a measure of the

volatility of stock price. Price variance is calculated for each day as the variance of the previous ten days' returns. The bid-ask spread is expected to be positively correlated with price variance.

The error term, ϵ_t, is assumed to satisfy the standard OLS assumptions.

Tests of Hypotheses

This section restates the hypotheses developed earlier in their testable forms and discusses specific methodology to be used for each hypothesis.

If there exists insider trading before the first public announcement of a takeover, and abnormal price behavior before the announcement is in fact due to insider trading, we should observe the bid-ask spread to widen during this period. Hence the testable hypothesis of Hypothesis 1 is:

H_0: $\beta_5 = 0$

The specialist either does not have the ability to infer information from the trading pattern or is indifferent to information trading because his spread already has taken into account the potential loss.

H_1: $\beta_5 > 0$

The specialist has the ability to detect information trading and the market is efficient.

β_5 is the coefficient of the dummy variable in the basic regression model (equation (1)).

Hypothesis 1 implies that once the announcement is made, the level of information asymmetry should go down to the normal level. That is, it is expected that β_5 following the announcement.

Although theory predicts an increase in the bid-ask spread when the degree of information asymmetry becomes greater, at the same time, theory is mute on how long the spread should remain larger. It may very well be that the specialist increases the spread for a short period of time[7]. If this is the case, it is less likely to detect a significant increase in the spread as the increased spreads are averaged out over 21 trading days. For this reason, one needs to conduct subperiod analyses. That is, instead of using the whole 21 days as the test period, shorter periods are used as the test period. This analysis is particularly helpful to figure out in which period the specialist becomes informed of the pending event.

There exists another problem which may jeopardize the detection of a change in the level of information asymmetry. In a regression analysis, we in essence try to find the period in which more specialists become aware of the information arrival. It may be that at the extreme the number of specialists who become informed is evenly distributed over the 21 day period. In this case, it is unlikely to detect a significant change in the coefficient of the dummy variable. To circumvent this problem, we group the firms according to the size of the average abnormal

daily volume for a specified period (we use a five-day period), and perform regression analyses on these subsamples[8].

Hypothesis 2 can be rewritten in the testable form as follows:

H_0: $\pi_0 = \pi_1$

There is no change in the auto-correlation coefficient between the estimation and the test periods.

H_1: $\pi_0 < \pi_1$

The auto-correlation coefficient becomes larger in the test period.

π_0 and π_1 represent the auto-correlation coefficients in the estimation and the test periods respectively.

The auto-correlation coefficient is calculated for each firm in each period[9]. We employ the Wilcoxon rank sum test method to evaluate the change in the correlation coefficient between the two periods. A non-parametric method is used because we are more interested in the direction of the change in the auto-correlation coefficient than the magnitude of the change. However, the Wilcoxon rank sum test takes into account both the direction and the magnitude of the change.

The absolute difference of the correlation coefficient in the two periods is calculated and sorted in an ascending order. Rank one is given to the smallest value. Then calculate the sum of the ranks of the differences having the predicted directional change. In our problem, we obtain the

sum of only positive changes. Denote this sum as T^+. Then, by the large sample approximation, the test statistic, T^*, follows the normal distribution (see Hollander and Wolfe (1973)).

$$T^* = \frac{T^+ - E(T^+)}{\sigma(T^+)}$$

where

$E(T^+) = n(n+1)/4$

$\sigma(T^+) = (n(n+1)(2n+1)/24)^{1/2}$, and

n = the number of observations.

The null hypothesis is rejected if

$T^* \geq Z(\alpha)$,

where Z(.) denotes the standard normal variable and α the significance level.

The test of hypotheses 3A and 3B involves a test of the equality between subsets of coefficients in two linear regressions. The basic regression model is run on each of friendly and hostile tender offers data, and then the estimated coefficients of the dummy variable are compared. The resulting testable hypothesis is as follows:

H_0: $\beta_5(F) = \beta_5(H)$

The magnitude of change in the level of information asymmetry is identical regardless of the type of tender offers.

H_1: $\beta_5(F) < \beta_5(H)$

The level of information asymmetry remains substantial for hostile offers while no uncertainty is left to be resolved for friendly offers.

F and H stand for 'friendly' and 'hostile' tender offers respectively.

The statistical significance test to be used is a standard t-test to compare the two coefficient estimates from separate regression analyses.

$$t = \frac{\beta_5(H) - \beta_5(F)}{\sigma(\beta_5(H)-\beta_5(F))}$$

where $\beta_5(H)$ and $\beta_5(F)$ are coefficient estimates of the dummy variable for 'hostile' and 'friendly' tender offers data sets respectively.

$\sigma(\beta_5(H)-\beta_5(F)) = \{\sigma^2(\beta_5(H)) + \sigma^2(\beta_5(F))\}^{1/2}$.

It is assumed that $cov(\beta_5(H),\beta_5(F)) = 0$. This assumption is not unreasonable since the two data sets are independent and not contemporaneously correlated.

The testable hypothesis of Hypothesis 4 is as follows:

H_0: $\beta_5(M) = \beta_5(TO) = \beta_5(LB)$

There exists no difference in the nature of information asymmetry among different techniques of takeovers.

H_1: $\beta_5(M) > \beta_5(TO)$ or $\beta_5(M) > \beta_5(LB)$

The level of information asymmetry for mergers is greater than that for tender offers or leveraged buy-outs.

The method for a statistical significance test to be employed will be identical to that used for the test of Hypothesis 3 except for the data sets used for comparison. The analysis of variance will be used to evaluate any difference in the coefficient estimates of the dummy variable among different takeover methods.

The hypothesis about the timing of the specialist being informed is given below and will be tested utilizing the results of the subperiod analysis for Hypothesis 1.

H_0: $N(M) = N(TO) = N(LB)$

The number of firms of each takeover technique will be the same in the sample which shows a significant increase in information asymmetry.

H_1: $N(M) > N(TO)$ and $N(M) > N(LB)$

There will be more merger firms in the sub-sample than target firms of other techniques.

$N(.)$ is defined as the number of the firms of a takeover type in the subsample divided by the total number of firms of that type in the full sample. For instance, if there are 28 mergers, 15 tender offers and 5 LBO's in the subsample, then $N(M) = 28/61$, $N(TO) = 15/61$, and $N(LB) = 5/24$.

Hypothesis 5 is tested on subsamples based on firm size. To the extent that the observed market spread bears little relationship with the costs of the specialist, the goodness of fit of the regression, as measured by R^2, and the significance level of each explanatory variable will be low. Further, the spread may not fully reflect the

information costs either. Hence we have the following testable hypothesis.

H_0: $R^2(S1) = R^2(S2) = R^2(S3) = R^2(S4) = R^2(S5)$

R^2's of regressions on each subsample are identical. That is, goodness of fit for each subsample is identical.

H^1: $R^2(S1) > R^2(S2) > R^2(S3) > R^2(S4) > R^2(S5)$

Size 1 shows the best goodness of fit and Size 5 the worst.

Notes

1. For instance, the Bendix Corporation was eliminated from the sample because it was too difficult to identify the first public announcement as the messy takeover battle involves firms as the bidder and the target at the same time.

2. Empirical studies report a negative relationship between the percentage spread and price. Hence, stock splits and stock dividends have the effect of increasing the percentage spread while at the same time this effect is partially offset by increasing the number of shares and thus the trading volume.

3. See the Appendix A for a complete list of firms.

4. A tender offer is defined as friendly if the target firm management does not oppose to the offer. Otherwise it is a hostile tender offer.

5. Keown and Pinkerton (1981) refer to as insiders not only those who have to report to the S.E.C., but also friends and relatives of insiders whose trades are very difficult to monitor. This is not unreasonable considering the Ivan Boesky case.

6. Report of the Special Study of the Securities Markets of Securities and Exchange Commission (88th Congress, 1st

session, House Document 95, 1963, Washington, D.C.: Government Printing Office.

7. Glosten and Milgrom suggest spreads decline with trade because the transaction prices are informative.

8. Daily trading volume appears to be the best differentiating variable because of its importance in determining both the holding cost and the information cost components of the spread. However, if we use trading volume as the differentiating variable, we may get a biased result in the test of Hypothesis 4. As can be seen in Table 3-3, tender offers experience 74% increase in trading volume whereas LBO's and mergers show only 30% and 19% increase. Thus, one should caution in interpreting the results.

9. The correlation coefficient, π_i, is defined as

$$\pi_i = \frac{\mathrm{cov}(r_{it}, r_{it-1})}{\sigma(r_{it}) * \sigma(r_{it-1})}$$

where r_{it} and r_{it-1} are the rate of return of stock i and its one period lag respectively.

CHAPTER IV
EMPIRICAL RESULTS AND DISCUSSION

The results of empirical tests of the bid-ask spreads are presented in two parts. In the first part, the results of the event study are given. This shows the behavior of gross spreads (before adjusted for holding costs) and volume of trading around takeover announcements. In the second part, the behavior of bid-ask spreads after adjusted for holding costs is described.

Behavior of Gross Spreads and Volume of Trading

Table 4-1 presents average abnormal percentage deviation of spreads around the takeover announcement of the full sample of 146 takeover target firms. Except for days -20 and -15, spreads display considerable decreases from the normal level before and after the takeover announcement. Statistically significant deviations from the normal level are found on days -14, -11, -7, -5, and from the day -3 onwards. It can be seen from Table 4-1 that the spreads keep decreasing before the takeover announcement is made. Between the day -5 and -1, specialists lowered spreads by significant 12.8% on daily average, and at and after the announcement spreads experience substantial reduction of about 39% . This finding is contradictory to the conjecture

that specialists will raise their spreads to protect themselves from insider trading. Results are rather suggestive of a decrease of information asymmetry. However, one should not jump to this conclusion because differences in holding costs around takeover announcements may have caused a decrease in gross spreads even if the information cost component of the spread has actually increased.

Consistent with other studies (see Keown and Pinkerton (1981)), daily volume of trading shows a significant increase around the announcement. Table 4-2 shows average abnormal percentage deviations of daily volume of trading are all positive in the test period. Statistically significant deviations are observed as early as on the days -21, -18, -16, -14, -13, and -11. From the day -9 onwards average deviations are all statistically significant. Further, Table 4-3 shows an average increase of about 37% between day -10 and -6, and this figure goes up to about 134% in the next five day period. This evidence of huge abnormal trading pattern may be an indication of trading based on special information, which will be investigated in the next section. On the event day and the following day, specialists experience daily volume of trading of about 14 times its normal level. Trading somewhat slows down in the next six day period, but it still remains at the level of about 5 times more than its normal level.

As microstructure theory predicts a negative relationship between spreads and trading volume, the

Table 4-1
Average Abnormal Percentage Deviation of Spreads:
(Before adjusted for holding costs)

Day	AR(S)[a]	t-statistic
-21	-0.0316	-0.48
-20	0.0645	0.97
-19	-0.0150	-0.23
-18	-0.0765	-1.16
-17	-0.0033	-0.05
-16	-0.0093	-0.14
-15	0.0400	0.60
-14	-0.1280	-1.93 *
-13	-0.0796	-1.20
-12	-0.0737	-1.11
-11	-0.1126	-1.70 *
-10	-0.0018	-0.03
-9	-0.0672	-1.02
-8	-0.1072	-1.62
-7	-0.1467	-2.22 **
-6	-0.0504	-0.76
-5	-0.1128	-1.70 *
-4	-0.0629	-0.95
-3	-0.1751	-2.64 ***
-2	-0.1291	-1.95 *
-1	-0.1586	-2.40 ***
0	-0.3452	-5.21 ***
1	-0.3676	-5.55 ***
2	-0.3723	-5.62 ***
3	-0.4291	-6.48 ***
4	-0.3655	-5.52 ***
5	-0.3757	-5.67 ***
6	-0.4269	-6.45 ***
7	-0.4213	-6.36 ***

* significant at 10% level using a two-tail test
** significant at 5% level using a two-tail test
*** significant at 1% level using a two-tail test

[a]Average abnormal percentage deviation of spread is defined as

$$AR(S)_t = \sum_i APS_{it}, \quad i=1,146.$$

APS_{it}, abnormal percentage deviation of spread is defined as

$$APS_{it} = \frac{S_{it} - \mu(s)_i}{\mu(s)_i}$$

where S_{it} and $\mu(s)_i$ are the proportional spread of firm i on day t and its mean.

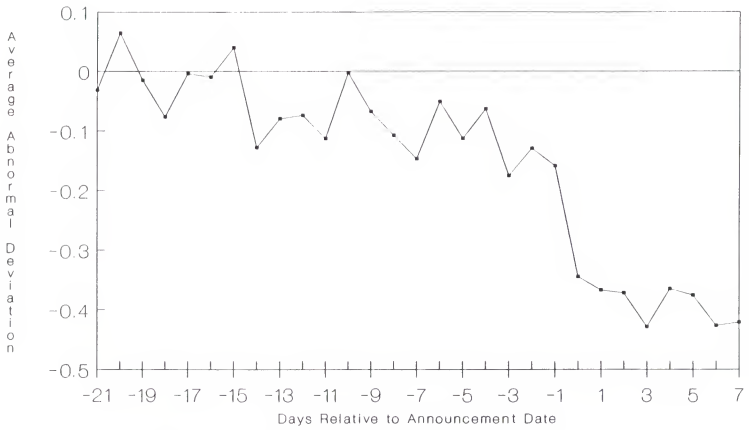

Figure 4-1 Average Abnormal Percentage Deviation of Ask-Bid Spreads

Table 4-2
Average Abnormal Percentage Deviation of Volume of Trading

Day	AR(V)	t-statistic
-21	0.2515	2.00 **
-20	0.1861	1.48
-19	0.1386	1.10
-18	0.4067	3.23 ***
-17	0.1181	0.94
-16	0.2739	2.18 **
-15	0.1204	0.96
-14	0.2458	1.95 *
-13	0.2523	2.00 **
-12	0.0274	0.22
-11	0.2406	1.91 *
-10	0.1932	1.53
-9	0.2587	2.06 **
-8	0.4001	3.18 ***
-7	0.5168	4.11 ***
-6	0.4929	3.92 ***
-5	0.5943	4.72 ***
-4	0.7096	5.64 ***
-3	0.8454	6.72 ***
-2	1.3230	10.51 ***
-1	3.2303	25.67 ***
0	15.5770	123.77 ***
1	11.7474	93.34 ***
2	7.7416	61.51 ***
3	5.7704	45.85 ***
4	4.5155	35.88 ***
5	4.5493	36.15 ***
6	3.7452	29.76 ***
7	4.1740	33.16 ***

* significant at 10% level using a two-tail test
** significant at 5% level using a two-tail test
*** significant at 1% level using a two-tail test

[a]Average abnormal percentage deviation of volume is defined as

$$AR(V)_t = \sum_i APV_{it}, \quad i=1,146.$$

Abnormal percentage deviation of volume, APV, is defined as

$$APV_{it} = \frac{V_{it} - \mu(v)_i}{\mu(v)_i}$$

where V_{it} and $\mu(v)_i$ are daily trading volume of firm i and its mean respectively.

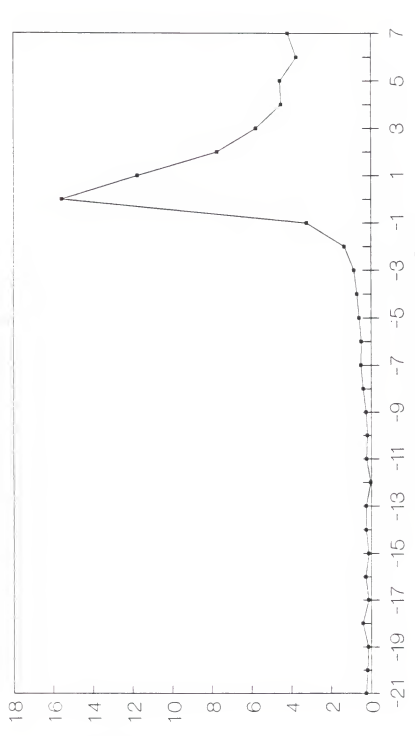

Figure 4-2 Average Abnormal Percentage Deviation of Daily Volume of Trading

decrease in spreads before and after takeover announcements may be partly explained by the big increase in trading volume. Yet, a study of Tables 4-1, 4-2 and 4-3 shows that a significant volume increase precedes a decrease in bid-ask spreads. In the period between day -10 and -6, we observe a significant deviation of trading volume by about 37% from the normal level. This level is also almost 20% higher than that of the preceding period between day -15 and day -11. However, in the same period, spreads show an increase in size from the negative 8.7% deviation to the negative 7.5% deviation from the normal level. Moreover, neither of these are statistically significant. This might be indicative of

Table 4-3
A Comparison of Subperiod Average Deviation

Period	Spread	t(s)	Volume	t(v)
Day -21 to -16	-0.025	-0.37	0.229	1.82 *
Day -15 to -11	-0.087	-1.31	0.177	1.41
Day -10 to -6	-0.075	-1.12	0.372	2.96 ***
Day -5 to -1	-0.128	-1.92 *	1.338	10.64 ***
Day 0	-0.345	-5.21 ***	13.655	108.54 ***
Day +1 to +7	-0.388	-5.85 ***	5.078	40.36 ***

* significant at 10% level using a two-tail test.
** significant at 5% level using a two-tail test.
*** significant at 1% level using a two-tail test.

an increase in information asymmetry in the period between the day -10 and -6. Any definitive conclusion, of course, should be postponed until later.

Behavior of Bid-Ask Spreads Adjusted for Holding Costs

Results of regression analysis investigating any change in the level of information asymmetry using the full sample are presented in Table 4-4. We conjectured that due to insider trading prior to public announcement of takeover attempts, the information cost component of the bid-ask spread will increase before the announcement of a takeover. Further, once the information becomes public, there should no longer be a trace of information asymmetry beyond the normal level. This change in the level of information asymmetry is captured by the coefficient of the dummy variable in our model.

Table 4-4 reports a small and statistically insignificant coefficient estimate of the dummy variable in the pre-announcement period. Therefore, we fail to reject the null hypothesis in the test of Hypothesis 1 which states the specialists do not have the ability to infer information from the trading pattern. However, we may have failed to obtain a significant coefficient estimate because specialists may increase the spread for a very brief period and/or such increases by individual specialists may be dispersed over the 21 day test period. If this in fact is the case, it would be unlikely to detect any significant

change in the information cost component of the spread. Hence, we need to conduct sub-period analyses before we make any conclusion about the specialists' ability to infer information from the behavior of prices and/or the trading pattern.

The results for the announcement date is consistent with our hypothesis. The insignificant coefficient estimate

Table 4-4

Regression Analysis Results of Changes in the Level of Information Asymmetry (Full Sample)

a. Pre-Announcement Period[a]

Model:
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy.

β_0	β_1	β_2	β_3	β_4	β_5
-2.006	-0.702	-0.079	0.050	-0.011	0.044
(-82.26)[b]	(-99.03)	(-32.82)	(13.92)	(-2.19)	(1.56)

b. Announcement Date

-2.017	-0.698	-0.079	0.052	-0.052	0.219
(-75.53)	(-87.19)	(-32.67)	(12.92)	(-2.38)	(1.19)

c. Post-Announcement Period

-1.963	-0.716	-0.077	0.043	0.006	-0.399
(-76.92)	(-94.80)	(-31.96)	(11.36)	(0.81)	(-6.94)

[a]Pre-announcement period covers the period from the day -21 to -1 and post-announcement runs from the day +1 to +7.

[b] t-statistics in parentheses

for the announcement date indicates that information asymmetry following the announcement does not differ from the normal level. On the other hand, the significant negative coefficient of the dummy variable suggests that in the week following the takeover announcement, the level of information asymmetry has gone down below the normal level. This can not be explained by full resolution of uncertainty regarding the ultimate consummation of the takeover bid. The significant negative value of the estimate may imply that uncertainly about the future course of action of the target firm's stock is removed from the standpoint of the specialists. In other words, as a target firm is acquired by another firm and its stock will cease to trade on the Exchange, the probability of information trading on the stocks of the target firm in the future becomes smaller, and accordingly the information costs are reduced below the normal level. In light of the fact that the normal level of information costs represents the long-term average information costs, which is just sufficient to compensate the expected information costs, a reductien in the long-term average costs is not unreasonable.

In the sub-period analysis, the 21-day pre-announcement period is broken into three seven-day periods, seven three-day periods, and six one-day periods. Regression analyses using the equation (1) in Chapter III are conducted on these sub-periods. Results of these analyses are provided in Table 4-5.

Table 4-5

Sub-period Regression Analysis
of the Pre-Announcement Period

a. Period of Seven Trading Days

Model:
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy

Period	β_0	β_1	β_2	β_3	β_4	β_5
day -21	-2.201	-0.697	-0.079	0.052	0.001	-0.012
to -15	(-76.27)[a]	(-88.00)	(-32.70)	(13.03)	(0.06)	(-0.18)
day -14	-2.004	-0.703	-0.079	0.050	-0.009	0.032
to -8	(-77.10)	(-91.02)	(-32.48)	(12.74)	(-1.13)	(0.69)
day -7	-2.014	-0.699	-0.079	0.053	-0.023	0.120
to -1	(-77.55)	(-90.62)	(-32.82)	(13.71)	(-3.03)	(2.59)**

b. Period of Three Trading Days

day -21	-2.021	-0.697	-0.079	0.052	0.001	-0.012
to -19	(-76.27)	(-88.00)	(-32.70)	(13.03)	(0.06)	(-0.18)
day -18	-2.018	-0.698	-0.079	0.052	0.000	-0.024
to -16	(-76.22)	(-88.18)	(-32.64)	(12.77)	(0.02)	(-0.36)
day -15	-2.012	-0.700	-0.079	0.050	-0.009	0.026
to -13	(76.04)	(-88.55)	(-32.56)	(12.63)	(-0.81)	(0.38)
day -12	.012	-0.700	-0.079	0.051	0.005	-0.046
to -10	(-75.82)	(-88.23)	(-32.52)	(12.72)	(0.41)	(-0.66)
day -9	-2.016	-0.699	-0.079	0.052	-0.013	0.066
to -7	(-76.15)	(-88.27)	(-32.71)	(13.14)	(-1.16)	(0.99)
day -6	-2.016	-0.699	-0.079	0.053	-0.030	0.163
to -4	(-76.20)	(-88.32)	(-32.75)	(13.21)	(-2.58)	(2.35)**
day -3	-2.014	-0.699	-0.079	0.053	-0.027	0.144
to -1	(-75.86)	(-88.08)	(-32.64)	(13.16)	(-2.39)	(2.00)**

Table 4-5--Continued

c. Period of One Trading Day

Period	β_0	β_1	β_2	β_3	β_4	β_5
day -6	-2.016	-0.699	-0.079	0.053	-0.021	0.109
	(-75.29)	(-87.01)	(-32.67)	(13.07)	(-1.04)	(0.94)
day -5	-2.019	-0.698	-0.079	0.052	-0.033	0.180
	(-75.41)	(-86.89)	(-32.67)	(12.92)	(-1.56)	(1.43)
day -4	-2.016	-0.699	-0.079	0.052	-0.037	0.202
	(-75.36)	(-87.05)	(-32.63)	(12.78)	(-1.92)	(1.73)*
day -3	-2.016	-0.699	-0.079	0.052	-0.061	0.307
	(-75.27)	(-87.03)	(-32.64)	(12.98)	(-2.88)	(2.40)**
day -2	-2.018	-0.698	-0.079	0.052	-0.008	0.041
	(-75.29)	(-86.84)	(-32.63)	(12.86)	(-0.40)	(0.33)
day -1	-2.016	-0.699	-0.079	0.052	-0.024	0.145
	(-75.15)	(-86.87)	(-32.57)	(12.82)	(-1.31)	(1.19)

* significant at 10% level using a one-tail test
** significant at 5% level using a one-tail test

a: t-statistics in parenthesis.

The coefficient estimates of the dummy variable were insignificant for first two seven-day periods, periods of day -21 to -15 and day -14 to -8. The coefficient becomessignificantly positive in the last seven-day period which runs from the day -7 to -1. This indicates that specialists have the capability to detect the increased level of information trading or become suspicious of informatior trading and raise the bid-ask spreads to protect themselves. In the three-day sub-period analyses, the coefficients of the dummy variable are all insignificant

except for the last two three-day periods. Since these two periods together coincide with the last seven-day period, this finding confirms results from the seven-day period analyses.

We postulated in the event study section that the slight decrease in the five-day average of spreads (a decrease from the preceding five-day average), coupled with a significant increase in trading volume, might indicate an increase in information asymmetry. This conjecture is not supported by the subperiod analysis.

To further test on which day specialists become suspicious, we conduct analyses on one-day periods. From results of seven-day and three-day period analyses, a sample of six one-day periods is decided on. Results of the one-day period analyses show more specialists begin to suspect information trading on day -4 and day -3. Daily trading volume of these two days is about 80% higher than the normal level (see Table 4-2). Notice that trading volume jumps to 132% and 323% higher than the normal level on days -2 and -1. Yet, information cost component of the spread is reduced to an insignificant level. This evidence suggests that specialists come to suspect information trading at the last moment and raise the spread only for a short period of time. It is also consistent with the postulate that the specialists have become certain of the pending event and thus raise the prices, not the spreads. By days -2 and -1, takeovers are no longer secrets.

The findings so far constitute evidence for market efficiency as discussed earlier. Nevertheless, there exists a substantial time lag between the initial start of insider trading and its detection. Therefore, although the market is fairly efficient in transmitting information, it is not strongly efficient such that information is caught instantaneously.

Results of three sub-periods analyses consistently report the significantly positive coefficient of the dummy variable in at least one of the sub-periods. Thus, we reject the null hypothesis of Hypothesis 1. In other words, evidence from sub-period analyses suggests that specialists have the ability to infer information[1] from trading pattern and the timing of inference is when the abnormal trading is right before its pre-announcement peak.

Table 4-6 summarizes changes in serial correlation coefficients between the estimation and the test periods. On average, auto-correlation coefficients have experienced a small increase. This increase in auto-correlation mostly comes from the sample with $\pi_0 < 0$. Also note that the sample with $\pi_0 > 0$ displays a decrease in auto-correlation coefficients. Earlier studies[2] show a negative relationship between auto-correlation and firm size. However, Table 4-6 shows little difference in firm size between two samples. This may be caused by the firm of over $ 13 billion in size. When we remove the out-lier firm, the average firm size of the sample with negative auto-correlation becomes $ 458.83

Table 4-6
Summary Statistics of Changes in
Autocorrelation Coefficients

a. Full sample

N	Variable[a]	Minimum	Maximum	Mean	Std. Dev.
146	π_0	-0.36	0.50	0.04	0.15
	π_1	-0.98	0.76	0.06	0.28

b. Sample with π_0

54	π_0	-0.36	-0.00	-0.11	0.08
	π_1	-0.49	0.62	0.02	0.26
	Vol	48.00	3933.00	499.41	722.94
	Size	2.74	13058.04	692.15[b]	1847.64

c. Sample with π_1

92	π_0	0.00	0.50	0.13	0.09
	π_1	-0.98	0.76	0.08	0.30
	Vol	9.00	5359.00	662.01	836.11
	Size	17.95	5380.97	722.10	986.19

[a] π_0 and π_1 are autocorrelation coefficients in the estimation and test periods.

[b] The average firm size of the sample with $\pi_0 < 0$ becomes 458.83 million but for the firm with $13 billion in size.

Table 4-7

Non-Parametric Tests of Changes in Autocorrelation Coefficients

H_0: $\pi_0 = \pi_1$ vs H_1: $\pi_0 < \pi_1$[a]

a. Rank sum tests

Sample	N	N^+[b]	T*[c]
Full Sample	146	83	0.0923
Sample with $\pi_0 < 0$	54	38	2.9692 ***
Sample with $\pi_0 \geq 0$	92	45	-1.5278

b. Sign tests

Sample	N	N^+[b]	T*[c]
Full Sample	146	83	1.6552 **
Sample with $\pi_0 < 0$	54	38	2.9938 ***
Sample with $\pi_0 \geq 0$	92	45	-0.2085

** Significant at 5% level using a one-tail test.
*** Significant at 1% level using a one-tail test.

[a] π_0 and π_1 represent autocorrelation coefficients in the estimation and test periods respectively.

[b] Number of firms which show a positive change in autocorrelation coefficients.

[c] Test statistic, T*, follows the normal distribution and is defined as

$$T^* = \frac{T^+ - E(T^+)}{\sigma(T^+)}$$

where $E(T^+)=n(n+1)/4$ and $\sigma(T^+)=\sqrt{n(n+1)(2n+1)/24}$ for the rank sum tests, and $E(T^+)=n/2$ and $\sigma(T^+)=\sqrt{n/4}$ for the sign tests.

million which is not only much smaller than the average firm size of the sample with positive auto-correlation, but more consistent with earlier findings.

Arithmetic averages can be deceiving because it can be affected by out-liers. It is particularly so for our purpose since we look for a directional change in auto-correlation coefficients across firms. Results of non-parametric tests are presented in Table 4-7. Whereas the Wilcoxon sign test completely ignores the magnitude of changes, the Wilcoxon rank sum test considers both the sign and the magnitude with the influence of the out-liers significantly reduced. We perform both tests.

For the full sample, 83 of 146 firms exhibit a positive change in auto-correlation. The rank sum test and the sign test report inconsistent results for the full sample. The increase in auto-correlation coefficients in the test period is statistically insignificant in the rank sum test while it is significant at 10% level in the sign test. Hence the null hypothesis of Hypothesis 2 fails to be rejected according to the rank sum test while we reject the null hypothesis according to the sign test. Just as in the test using the bid-ask spreads, we may be able to find a significant positive change in auto-correlation in stock returns in the last seven days before the announcement. However, the estimated auto-correlation coefficients are too sensitive to the estimation period. We do not continue with a shorter period as too short a period is not reliable. The

use of intra-day transactions data will improve the reliability of tests.

The sample with negative autocorrelation shows 38 out of 54 firms have experienced a positive change in auto-correlation and 45 of 92 firms in the sample with positive correlation show a positive change. The positive change becomes obvious for the sample with negative serial correlation for which 38 of 54 firms show the positive change. Both tests confirm a significant change for this sample. The change in auto-correlation for the sample with positive auto-correlation is found to be insignificant in both tests. The results in sub-sample analyses suggest a mean reversion process of serial correlation coefficients, which further reduces the reliability of the test using auto-correlation coefficients.

Regression analysis results for friendly and hostile tender offers are provided in Table 4-8. In the pre-announcement period, neither type shows significant estimates of the coefficient of the dummy variable, which is consistent with the full sample results. The relative magnitude of the two estimates is consistent with the hypothesis that there is no difference in the size of the change in the information cost between friendly and hostile tender offers before the announcement. The statistical test performed to measure the difference between the two types confirms this observation (see Table 4-9).

Table 4-8
Regression Analysis Results:
Friendly vs. Hostile Tender Offers[a]

a. Pre-Announcement Period

Model:
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy

	β_0	β_1	β_2	β_3	β_4	β_5
Friendly	-1.545	-0.834	-0.069	0.025	0.002	-0.020
	(-31.59)[b]	(-57.41)	(-13.27)	(3.44)	(0.15)	(-0.32)
Hostile	-1.959	-0.671	-0.106	0.055	-0.004	-0.023
	(-29.74)	(-37.94)	(-17.50)	(6.74)	(-0.36)	(-0.29)

b. Announcement Date

Friendly	-1.500	-0.851	-0.067	0.023	0.031	-0.543
	(-27.95)	(-51.44)	(-12.64)	(2.80)	(0.54)	(-1.05)
Hostile	-1.944	-0.677	-0.104	0.047	-0.072	0.488
	(-27.31)	(-34.32)	(-17.10)	(5.18)	(-1.25)	(0.89)

c. Post-Announcement Period

Friendly	-1.480	-0.858	-0.067	0.021	0.074	-1.070
	(-29.13)	(-55.46)	(-12.76)	(2.80)	(4.51)	(-8.41)***
Hostile	-1.922	-0.684	-0.103	0.042	-0.022	-0.040
	(-28.07)	(-36.66)	(-17.06)	(4.92)	(-0.95)	(-0.21)

*** significant at 1% level using a two-tail test

[a]A tender offer is friendly if the target management does not oppose the bid. Otherwise, it is hostile.

[b]t-statistics in parenthesis.

At the announcement date, the coefficient estimates are insignificant for both types, but it is negative, albeit statistically insignificant, in the case of friendly tender offers while it is positive and greater than its pre-announcement level in the case of hostile tender offers. However, the statistical test shows that the difference is not statistically significant. It may be that the friendly or hostile nature of the takeover is in general known in the week following the announcement, not on the very day of the announcement because the target management takes time to study the bid before they announce whether or not the offer

Table 4-9

Comparison of Hostile and Friendly Tender Offers

Period	t^a
Pre-Announcement	0.021
At Announcement	-0.968
Post-Announcement	-3.242 ***

*** significant at 1% level using a two-tail test

a $$t = \frac{\beta_{5f} - \beta_{5h}}{\sigma(\beta_{5f} - \beta_{5h})}$$

where β_{5f} and β_{5h} are coefficient estimates of the dummy variable for 'friendly' and 'hostile' tender offers, respectively.
$\sigma(\beta_{5f}-\beta_{5h}) = [\sigma^2(\beta_{5f}) + \sigma^2(\beta_{5h})]^{1/2}$.

is welcome. This may explain why the difference between two types on the announcement day is insignificant.

In the post-announcement period, a wide disparity of reaction to different types of tender offers is observed. For the friendly type, the coefficient estimate of the dummy variable has become very significantly negative whereas that for the hostile type remains insignificant. The Chow test result reported in Table 4-9 confirms that the difference between the two types of tender offers is statistically significant. Hence, we reject the null hypothesis of Hypothesis 3A. This hypothesis test provides evidence that specialists do adjust their bid-ask spreads based upon the degree of their exposure to information asymmetry.

Table 4-10 reports regression results for different techniques of takeovers. If the information leakage affects the stock's trading pattern (trading frequency, trading volume, etc.) and if specialists are able to infer information from trading pattern, we should observe a statistically significant coefficient estimate of the dummy variable. Further, we hypothesized that if information is leaked over a longer period of time and thus the probability of the next trader being informed is greater, bigger spreads will be observed. As mergers involve, in general, a more lengthy process, we proposed that information costs before the announcement will be higher for mergers than other methods. In the pre-announcement period, however, there is no indication that there exists a significant difference

Table 4-10

Regression Analysis Results by Methods of Takeovers

a. Pre-Announcement Period

Model:
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy

Type	β_0	β_1	β_2	β_3	β_4	β_5
Tender Offer	-1.694 (-43.23)[a]	-0.766 (-68.19)	-0.092 (-23.10)	0.040 (7.29)	-0.005 (-0.65)	0.004 (0.08)
Merger	-2.170 (-60.59)	-0.659 (-63.57)	-0.076 (-21.50)	0.054 (9.55)	-0.008 (-1.12)	0.040 (1.00)
LBO	-2.124 (-25.18)	-0.700 (-29.43)	-0.064 (-9.09)	0.066 (7.39)	-0.014 (-0.91)	0.075 (0.88)

b. Announcement Date

Tender Offer	-1.661 (-38.94)	-0.776 (-61.29)	-0.089 (-22.51)	0.036 (5.87)	-0.016 (-0.39)	-0.069 (-0.19)
Merger	-2.197 (-56.09)	-0.650 (-55.84)	-0.077 (-21.65)	0.059 (9.35)	-0.048 (-1.34)	0.220 (0.81)
LBO	-2.232 (-23.68)	-0.606 (-24.54)	-0.065 (-9.11)	0.071 (7.11)	-0.032 (-0.39)	-0.055 (-0.08)

c. Post-Announcement Period

Tender Offer	-1.643 (-40.23)	-0.783 (-65.41)	-0.089 (-22.56)	0.032 (5.66)	0.067 (5.17)	-0.901 (-8.54)
Merger	-2.131 (-56.89)	-0.671 (-61.03)	-0.075 (-21.03)	0.047 (8.03)	-0.001 (-0.09)	-0.285 (-3.39)
LBO	-2.145 (-23.97)	-0.693 (-27.15)	-0.063 (-8.91)	0.060 (0.45)	0.006 (0.22)	-0.477 (-2.60)

a: t-statistics in parenthesis.

Table 4-11

Intra Pre-Announcement Period Analysis
By Methods of Takeovers

a. Tender Offers

Model:
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy

Period	β_0	β_1	β_2	β_3	β_4	β_5
day -21	-1.676	-0.771	-0.090	0.036	0.010	-0.094
to -15	(-40.44)	(-63.33)	(-22.73)	(6.10)	(0.78)	(-1.20)
day -14	-1.676	-0.771	-0.090	0.038	-0.005	0.023
to -8	(-40.38)	(-63.27)	(-22.72)	(6.43)	(-0.38)	(0.27)
day -7	-1.664	-0.776	-0.090	0.039	-0.017	0.072
to -1	(-39.99)	(-63.44)	(-22.63)	(6.53)	(-1.41)	(0.90)
day -7	-1.663	-0.776	-0.090	0.037	-0.014	0.043
to -4	(-39.51)	(-62.40)	(-22.57)	(6.11)	(-0.87)	(0.41)
day -3	-1.658	-0.778	-0.089	0.038	-0.022	0.121
to -1	(-39.02)	(-61.85)	(-22.47)	(6.17)	(-1.25)	(1.00)

b. Merger

day -21	-2.201	-0.648	-0.077	0.057	-0.007	0.030
to -15	(-58.04)	(-58.00)	(-21.63)	(9.35)	(-0.58)	(0.47)
day -14	-2.167	-0.660	-0.076	0.054	-0.006	0.014
to -8	(-56.67)	(-58.52)	(-21.35)	(8.77)	(-0.49)	(0.22)
day -7	-2.199	-0.649	-0.077	0.061	-0.016	0.092
to -1	(-57.68)	(-57.74)	(-21.80)	(9.96)	(-1.28)	(1.36)
day -7	-2.205	-0.647	-0.077	0.061	-0.014	0.104
to -4	(-57.11)	(-56.61)	(-21.81)	(9.78)	(-0.89)	(1.22)
day -3	-2.195	-0.650	-0.077	0.059	-0.013	0.049
to -1	(-56.37)	(-56.33)	(-21.64)	(9.48)	(-0.67)	(0.45)

c. LBO

Period	β_0	β_1	β_2	β_3	β_4	β_5
day -21	-2.191	-0.679	-0.064	0.069	0.032	-0.151
to -15	(-24.03)	(-26.01)	(-9.08)	(7.12)	(1.26)	(-1.10)
day -14	-2.164	-0.687	-0.064	0.067	-0.049	0.224
to -8	(-23.73)	(-26.34)	(-9.01)	(6.81)	(-1.71)	(1.45)
day -7	-2.186	-0.681	-0.064	0.069	-0.033	0.196
to -1	(-24.10)	(-26.23)	(-9.13)	(7.15)	(-1.44)	(1.49)
day -7	-2.201	-0.676	-0.064	0.070	0.002	-0.012
to -4	(-23.83)	(-25.49)	(-9.13)	(7.15)	(0.06)	(-0.06)
day -3	-2.209	-0.673	-0.064	0.070	-0.075	0.468
to -1	(-23.66)	(-25.08)	(-9.09)	(7.03)	(-2.28)	(2.36)

Table 4-12

Comparison of Various Methods of Takeover

Comparison	t^a
Tender Offer vs Merger	-0.562
Merger vs LBO	-0.372
Tender Offer vs LBO	-0.718

$$^a\ t = \frac{\beta_{5i} - \beta_{5j}}{\sigma(\beta_{5i} - \beta_{5j})}$$

where β_{5i}'s are coefficient estimates of the dummy variable for various takeover techniques i.
$\sigma(\beta_{5i} - \beta_{5j}) = [\sigma^2(\beta_{5i}) + \sigma^2(\beta_{5j})]^{1/2}$. $\text{cov}(\beta_{5i}, \beta_{5j}) = 0$.

among different methods of takeovers or that specialists can suspect information trading in any method of takeover. The t-test results in Table 4-12 validate this observation. Hence, we do not reject the null hypothesis that there is no difference in information asymmetry among various methods of takeover3.

Almost identical results are obtained for various techniques of takeover at the announcement date in Table 4-10. Coefficient estimates in all three methods are insignificant and show a small decrease compared to

Table 4-13

Test Results of Timing of Specialists Knowledge
By Methods of Takeover

Model:
Spread = b_0 + b_1Price + b_2Vol + b_3Var + b_4D*Vol + b_5Dummy

Period	b_0	b_1	b_2	b_3	b_4	b_5
Day -21 to -16	-2.140 (-47.83)	-0.686 (-53.21)	-0.064 (-14.65)	0.067 (9.81)	0.0009 (0.06)	-0.030 (-0.32)
Day -15 to -11	-2.063 (-49.27)	-0.678 (-52.22)	-0.080 (-19.36)	0.046 (7.43)	-0.030 (-1.97)	0.164 (1.83)**
Day -10 to -6	-1.833 (-39.39)	-0.778 (-52.44)	-0.068 (-16.63)	0.062 (8.39)	-0.028 (-1.71)	0.157 (1.57)*
Day -5 to -1	-2.175 (-40.37)	-0.656 (-40.65)	-0.074 (-17.42)	0.040 (5.99)	-0.024 (-1.1)	0.109 (1.02)

* significant at 10% level using a one-tail test
** significant at 5% level using a one-tail test

estimates of the pre-announcement period. In the post-announcement period, however, the estimates of the dummy variable become significantly negative, which is consistent with the full sample results.

The possibility that timing of specialists being informed varies according to timing of information trading by insiders is tested using stratified samples. We divide firms for each sub-period in three groups according to the increase in trading volume and perform regression analyses on the group which experienced the largest increase. Results of this analysis are reported in Table 4-13. For the two five-day periods between days -15 to -11 and between days -10 to -6, we have found a significant increase in information costs. This finding supports the hypothesis that specialists have the ability to detect information trading when it occurs. However, regression results in the last five-day period seems puzzling particularly because it is the period when the full sample exhibits a significant increase in information costs.

Table 4-14 presents regression results when the full sample is grouped according to firm size. In the pre-announcement period, three groups of smaller firm size exhibit a very similar behavior to the full sample result. Information cost changes show a small, insignificant, but positive gain. The group of the largest firm size (Size 5) results in a small, insignificant decrease in information

Table 4-14

Regression Analysis Results By Size

a. Pre-Announcement Period

Model :
Spread = β_0 + β_1Price + β_2Vol + β_3Var + β_4D*Vol + β_5Dummy

Size	β_0	β_1	β_2	β_3	β_4	β_5
1	-2.566	-0.584	-0.006	0.038	-0.026	0.072
	(-50.62)	(-41.67)	(-0.97)	(4.87)	(-2.25)	(1.44)
2	-2.328	-0.636	-0.043	0.057	-0.029	0.090
	(-30.68)	(-30.87)	(-6.74)	(7.82)	(-2.31)	(1.39)
3	-2.340	-0.651	-0.044	0.034	-0.013	0.076
	(-27.80)	(-30.18)	(-6.19)	(3.88)	(-0.87)	(0.88)
4	-2.537	-0.597	-0.045	0.061	-0.043	0.211
	(-28.58)	(-31.75)	(-5.42)	(7.26)	(-2.64)	(2.12)
5	-2.078	-0.719	-0.070	0.138	0.002	-0.031
	(-26.85)	(-37.80)	(-10.41)	(1.69)	(0.15)	(-0.30)

b. Announcement Date

1	-2.573	-0.582	-0.007	0.039	-0.088	0.188
	(-46.89)	(-37.61)	(-0.98)	(4.57)	(-1.43)	(0.46)
2	-2.317	-0.639	-0.045	0.062	-0.058	-0.002
	(-26.79)	(-26.64)	(-6.92)	(7.54)	(-0.91)	(-0.01)
3	-2.449	-0.620	-0.041	0.034	-0.125	0.724
	(-25.20)	(-24.30)	(-5.64)	(3.42)	(-1.88)	(1.31)
4	-2.640	-0.572	-0.042	0.059	-0.205	1.479
	(-27.31)	(-26.96)	(-5.04)	(6.35)	(-2.96)	(2.39)
5	-2.132	-0.072	-0.072	0.019	-0.531	0.383
	(-25.31)	(-32.60)	(-10.56)	(2.07)	(-0.85)	(0.63)

Table 4-14--Continued

C. Post - Announcement Period

Size	β_0	β_1	β_2	β_3	β_4	β_5
1	-2.469	-0.616	-0.005	0.024	-0.033	-0.243
	(-46.57)	(-41.82)	(-0.74)	(2.91)	(-1.65)	(-2.14)
2	-2.320	-0.638	-0.045	0.063	0.044	-0.858
	(-28.14)	(-28.15)	(-6.94)	(8.04)	(2.14)	(-6.03)
3	-2.414	-0.630	-0.039	0.021	0.018	-0.556
	(-26.05)	(-26.11)	(-5.41)	(2.31)	(0.75)	(-3.16)
4	-2.545	-0.596	-0.043	0.050	-0.067	-0.005
	(-27.18)	(-29.35)	(-5.20)	(5.69)	(-2.70)	(-0.03)
5	-2.046	-0.729	-0.070	0.015	0.014	-0.334
	(-25.30)	(-36.05)	(-10.38)	(1.72)	(0.59)	(-1.63)

Table 4-15
Comparison of Goodness of Fit*

	SIZE 1	SIZE 2	SIZE 3	SIZE 4	SIZE 5
PRE	0.492	0.321	0.273	0.284	0.382
AT	0.498	0.332	0.241	0.279	0.375
POST	0.535	0.419	0.329	0.379	0.433

*Values in the cell are adjusted R-squares of regression.

costs. The behavior of Group 4 is different from others in that it shows a significant increase in information costs.

The behavior of the information cost at announcement is consistent with the hypothesis that much of uncertainty is resolved with the public announcement of a takeover except for Group 4. Group 4 shows a significantly positive estimate of the dummy variable which is contradictory to the hypothesis that at announcement information asymmetry reduces to the normal level. While all other groups show a significant decrease in information costs, which is consistent with the findings of the full sample, only Group 4 shows a small, insignificant decrease. It may be that considerable amount of insider trading activity took place for stocks of firms in Group 4.

Table 4-15 reports that Group 1 has the largest R^2 value and R^2's decrease for Group 2 and 3. This decreasing pattern of R^2's is consistent with the hypothesis that spreads for small firms better reflect the costs the specialists incur in providing liquidity services to the market. However, R^2's increase for Group 4 and 5. And this pattern is consistently observed before, at and after the announcement. Larger than expected R^2's for Group 5 and 4 are inconsistent with the hypothesis, but may be explained by the data structure of Group 5. In Table 3-2, one can note Group 5 is widely different from others in terms of average trading volume and its dispersion. In a regression analysis, the more widely dispersed observations of an

independent variable are, the better fit it has. Hence, increased R^2 may be obtained even if the two variables have little economic relationship. We can also see in Table 4-14 that the gain in R^2 mainly comes from the trading volume variable. Both coefficient estimates and their t-values are significantly larger than those of other groups. Taking this into account and eliminating Group 5 from comparison, the behavior of R^2's is consistent with the hypothesis.

Notes

1. It may be interpreted so that immediacy providers including individuals placing limit orders collectively has the ability to detect information. The author owes this interpretation to Robert Radcliffe.

2. See CHMSW (1980) for a summary of the literature in this area.

3. We may have the same result if the reaction of the market maker has the time lag. For instance, suppose that insider trading on mergers and on tender offers begins two weeks and one week before the announcement, respectively, but the information content is stronger for tender offers. Then, the detection of the signal by the specialists may not be very far off.

CHAPTER V
SUMMARY AND CONCLUSION

Complex institutional arrangements have demanded revision of assumptions of classic economic analysis in many ways. One such recognition is the presence and effects of market makers on the determination of security prices. This research has been concerned with if the market makers on the New York Stock Exchange have the ability to detect the activity of insider trading around firm-specific events. We have selected takeover announcements as firm-specific information events.

Two different approaches are employed to test the hypothesis. First, the behavior of the bid-ask spreads is examined. Specifically, the behavior of the information cost component of the bid-ask component of the bid-ask spread is studied. An increase in the information cost component in the pre-announcement period constitutes evidence for the specialists' ability to detect inside information. Second, the behavior of serial correlation in security returns is investigated. As the proportion of the information cost component in the spread increases, the serial correlation coefficient moves in the positive direction.

Further, as a by-product of the hypothesis test, we can test tow competing hypotheses: (1) the pre-announcement price increases is due to information leakage from insider trading; (2) the pre-announcement price adjustments are unbiased responses to public information that increases the probability of a takeover.

Regression analysis results on the full sample in the pre-announcement period show no significant increase in information costs. Information costs remain at the normal level on the announcement day, and significantly reduced following the announcement. Sub-period analysis reveals that specialists have widened their bid-ask spreads one week before the public announcement of the takeover. Regression results on one-day period further show that the increase in the information costs occurred on day -4 and day -3.

These results are consistent with the hypothesis that specialists are able to detect abnormal trading based on non-public information and they increase their spreads to avoid loss to insiders. Or it may be that all providers of immediacy of transaction, including specialists, individuals placing limit orders, floor traders, etc, collectively have the ability to detect the arrival of information. In any event, information trading does not take place unnoticed. However, there is a time lag between the information dissemination via insider trading and its detection by the specialists.

The results of the analysis using sub-samples based on firms experiencing large increases in trading volume confirm the findings in the full sample sub-period analyses. Moreover, sub-sample results imply that specialists have the ability to detect insider trading when it takes place or at least the time lag is shorter, while the full sample results imply that specialists raise the spread only for a short period of time and just before daily trading volume's pre-announcement peak. This is much stronger evidence of the ability of the specialists and market efficiency.

Tests using auto-correlation coefficients yield mixed results. The rank sum test fails to reject that there is no significant increase in serial correlation while the sign test rejects it. Because of the small number of observations used to calculate autocorrelation coefficients, a caution should be taken in interpreting the results. The use of intra-day transaction prices data will enhance the reliability of the results.

Results from the comparison of friendly vs. hostile tender offers imply that specialists are concerned of the outcome of the takeover bid and adjust bid-ask spreads accordingly. However, the comparison of different methods of takeover reports no significant difference in information contents among them, which is inconsistent with our hypothesis.

As the transaction participation rate of the specialists is higher for thin stocks, we would expect their

spreads better reflect the costs the specialists incur in performing their economic function of providing liquidity. R^2's show a decreasing pattern which is consistent with the hypothesis. But the largest firm size group shows abnormal behavior. This abnormality may be partly explained by the abnormal dispersion of daily trading volume for this group. Without a formal test, however, it is inconclusive.

In summary, we have sufficient evidence to claim that the specialists on the New York Stock Exchange have, on average, the ability to detect information trading. We also conclude there exists a time lag before the specialists' detection. But our tests are not powerful enough to make any conclusion on how long the time lag is . The results imply that the market is fairly efficient in transmitting information, but not strongly efficient to produce an instantaneous transmittal of information. Evidence supports the hypothesis that the pre-announcement price increases are due to information leakage from insider trading. Specialists are also watchfully concerned of differential news contents that might affect their wealth significantly. Finally, specialists perform as a primary source of immediacy for thinly traded stocks and they are compensated for the risk they assume.

As a future extension of the study, we suggest the use of intra-daily transactions data to enhance the reliability of both tests using the bid-ask spreads and serial correlation coefficients. Another avenue of extension could

be to verify the time lag with a more powerful test methodology. If the time lag in fact exists, the next question will be whether it is due to the specialists' having no ability to detect the information arrival early or it is because they do become aware of the insider trading, but do not react to information until the probability of the arrival of the pending event is accumulated to a certain level.

APPENDIX A

Table A-1
The List of Sample Firms

CUSIP[a]	TYPE[b]	SIZE[c]	YEAR[d]	COMPANY NAME
001688	TH	422.72	85	A M F INC
002040	LB	552.79	84	A R A SVCS INC
006203	T	54.53	84	ADAMS DRUG INC
019519	TH	1596.12	86	ALLIED STORES CORP
019555	M	110.95	83	ALLIED TEL CO
024735	M	1925.61	85	AMERICAN BROADCASTING COS INC
026681	M	2234.72	85	AMERICAN HOSP SUPPLY CORP
028609	TH	1470.10	85	AMERICAN NAT RES CO
030087	LB	187.40	84	AMERICAN STERILIZER CO
032172	LB	241.27	83	AMSTAR CORP
032177	LB	468.21	85	AMSTED INDS INC
033849	M	67.58	86	ANDERSON GREENWOOD & CO
042627	T	65.39	85	ARO CORP
045573	TH	1319.35	86	ASSOCIATED DRY GOODS CORP
053501	M	650.17	84	AVCO CORP
053660	M	72.98	85	AVIALL INC
054595	LB	136.14	84	AXIA CORP
059442	M	153.70	83	BANCAL TRI ST CORP
060221	M	138.07	83	BANGOR PUNTA CORP
089671	T	986.61	86	BIG THREE INDS INC
092815	TH	164.89	86	BLAIR JOHN & CO
095293	LB	399.84	84	BLUE BELL INC
114394	LB	270.05	84	BROOKS FASHION STORES INC
136900	M	3276.76	85	CANADIAN PAC ENTERPRISES LTD
155177	TH	202.90	85	CENTRAL SOYA INC
157177	T	400.16	85	CESSNA AIRCRAFT CO
167898	TH	103.10	86	CHICAGO PNEUMATIC TOOL CO
186108	M	1333.18	85	CLEVELAND ELEC ILLUM CO
189486	TH	265.86	85	CLUETT PEABODY & CO INC
193288	M	224.20	84	COLE NATL CORP
195846	M	451.70	85	COLONIAL PENN GROUP INC
205889	LB	179.03	84	CONAIR CORP DEL
212867	M	342.01	85	CONWOOD CORP
218661	T	141.50	86	CORDURA CORP
224043	T	1432.02	85	COX COMMUNICATION INC
256129	LB	330.00	83	DR PEPPER CO
257660	T	252.86	84	DONALDSON LUFKIN & JENRETTEINC

Table A-1--Continued

CUSIP	TYPE	SIZE	YEAR	COMPANY NAME
278764	LB	989.61	85	ECKERD JACK CORP
285659	M	1896.87	84	ELECTRONIC DATA SYS CORP
300587	TH	693.61	86	EX CELL O CORP
316438	M	112.22	83	FIDELITY UN BANCORPORATION
319284	M	122.17	85	FIRST BANKERS CORP FLORIDA
358640	M	86.75	86	FRIGITRONICS INC
359370	TH	506.41	86	FRUEHAUF CORP
369100	M	123.15	85	GENERAL BANCSHARES CORP
369856	T	3332.21	85	GENERAL FOODS CORP
372451	TH	781.25	86	GENSTAR CORP
374280	T	5380.97	83	GETTY OIL CO
375149	M	190.23	86	GIFFORD HILL & CO INC
402733	M	484.65	85	GULFSTREAM AEROSPACE CORP
408306	T	582.11	86	HAMMERMILL PAPER CO
413841	M	232.31	83	HARRIS BANKCORP INC
414545	T	173.83	86	HARRIS GRAPHICS CORP
421596	T	116.08	86	HAZELTINE CORP
422199	M	300.73	86	HEALTHAMERICA CORP
427492	M	244.91	86	HERMANS SPORTING GOODS INC
439316	T	313.05	85	HOOVER UNVL INC
442272	T	1511.85	85	HOUSTON NAT GAS CORP
445582	M	111.63	84	HUNT PHILIP A CHEM CORP
456623	M	113.71	86	INEXCO OIL CO
456668	TH	89.35	85	INFORMATICS GEN CORP
477196	TH	563.95	84	JEWEL COS INC
479898	LB	145.27	84	JONATHAN LOGAN INC
501858	M	17.90	84	L F E CORP
515886	M	243.17	83	LANIER BUSINESS PRODS INC
526264	TH	233.89	83	LENOX INC
527364	LB	1096.27	85	LEVI STRAUSS & CO
547779	T	191.90	85	LOWENSTEIN M CORP
553013	M	692.27	85	M G M UA ENTMT CO
559108	M	390.36	86	MAGIC CHEF INC
561280	LB	422.77	84	MALONE & HYDE INC
573890	LB	308.17	85	MARY KAY COSMETICS INC
575418	M	80.99	85	MASS MERCHANDISERS INC IND
580628	LB	580.56	85	MC GRAW EDISON CO
582562	T	51.15	86	MC NEIL CORP
597715	T	266.88	86	MIDLAND ROSS CORP
601753	M	167.08	84	MILTON BRADLEY CO
607908	T	35.45	86	MODULAR COMPUTER SYS INC
608302	M	2.74	83	MOHAWK RUBR CO
616457	M	148.48	83	MORAN ENERGY INC
629135	T	326.49	85	N I INDS INC
629525	T	3161.69	85	NABISCO BRANDS INC
635128	LB	305.12	85	NATIONAL CAN CORP

Table A-1--Continued

CUSIP	TYPE	SIZE	YEAR	COMPANY NAME
636882	M	253.11	84	NATIONAL MED CARE INC
638760	TH	806.52	83	NATOMAS CO
641440	M	61.45	86	NEVADA SVGS & LN ASSN
667528	LB	890.79	84	NORTHWEST INDS INC
668707	LB	578.70	83	NORTON SIMON INC
682063	M	162.45	84	OMARK INDS INC
690326	T	643.42	86	OVERNITE TRANSN CO
694529	T	569.80	85	PACIFIC LMBR CO
696593	LB	142.02	85	PALM BEACH INC
697760	M	120.75	85	PAN AMERN BANKS INC
698822	LB	178.62	85	PAPERCRAFT CORP
704301	T	375.52	85	PAY LESS DRUG STORES NORTHWEST
704562	M	74.63	85	PEABODY INTL CORP
716544	T	730.97	84	PETROLANE INC
727108	T	136.01	86	PLANNING RESH CORP
730196	T	365.52	84	PNEUMO CORP
741029	M	72.61	84	PRESLEY COS
760354	M	82.58	84	REPUBLIC CORP
760779	M	374.23	83	REPUBLIC STL CORP
761406	T	95.19	86	REVERE COPPER & BRASS INC
761525	TH	1469.06	85	REVLON INC
763282	TH	808.96	85	RICHARDSON VICKS INC
767100	T	453.89	84	RIO GRANDE INDS INC
770519	M	252.05	86	ROBERTSHAW CTLS CO
775784	M	874.00	84	ROLM CORP
783878	M	214.30	84	S C A SVCS INC
784015	TH	466.07	85	S C M CORP
784150	LB	299.45	84	SFN COS INC
786599	TH	329.86	86	SAGA CORP
793453	TH	1168.08	84	ST REGIS CORP
799850	TH	630.30	86	SANDERS ASSOC INC
803701	M	85.63	86	SARGENT WELCH SCIENTIFIC CO
809123	LB	432.76	85	SCOA INDS INC
810640	TH	304.60	84	SCOVILL INC
812302	T	2840.34	85	SEARLE G D & CO
815246	M	740.32	84	SEDCO INC
816323	M	28.99	85	SELIGMAN & LATZ INC
822635	TH	13058.04	84	SHELL OIL CO
822737	M	235.94	86	SHELLER GLOBE CORP
826622	T	3511.96	85	SIGNAL COS INC
828675	M	141.31	83	SIMMONDS PRECISION PRODS INC
844521	TH	592.36	85	SOUTHLAND RTY CO
844768	M	347.93	83	SOUTHWEST BANCSHARES INC
848355	TH	2879.24	86	SPERRY CORP
865112	M	61.83	84	SULLAIR CORP
866635	M	539.22	84	SUN BANKS INC

Table A-1--Continued

CUSIP	TYPE	SIZE	YEAR	COMPANY NAME
867872	M	17.95	84	SUNSTATES CORP
868273	M	4472.61	84	SUPERIOR OIL CO
882435	TH	549.55	83	TEXAS GAS RES CORP
882593	M	3442.20	85	TEXAS OIL & GAS CORP
886296	LB	127.89	83	TI CARO INC
889175	M	630.06	85	TOLEDO EDISON CO
892892	TH	374.10	83	TRANE CO
894015	TH	224.75	85	TRANSWAY INTL CORP
895580	M	39.88	84	TRI SOUTH INVTS INC
902384	M	214.71	83	TYMSHARE INC
909160	TH	488.06	85	UNIROYAL INC
910210	T	784.18	85	UNITED ENERGY RES INC
912078	LB	325.99	84	UNITED STS INDS INC
929769	M	753.58	85	WACHOVIA CORP
963626	TH	516.07	86	WHITE CONS INDS INC
978165	M	571.63	83	WOMETCO ENTERPRISES INC
980140	M	247.82	85	WOODS PETE CORP

[a]The six digit company identification code reported in the CRSP tape.

[b]T, TH, M, and LB stand for friendly and hostile tender offers, mergers and leveraged buy-outs respectively.

[c]In million dollars.

[d]The year in which the announcement was made.

APPENDIX B

Table B-1 is adapted from the Report of the Special Study of Security Markets. Each cell in the table represents the percentage of stock days in each category of market volume falling into each range of specialist transaction participation rate. One stock day is defined as one day's observation on one stock. One can see from the table that for stocks trading 10,000 shares or more a day, by far the largest number of stock days falls into the category of the lowest specialist transaction participation rate while the smallest number of stock days is found in the category of the highest specialist participation rate. This trend is preserved for those stocks trading 2,100 or more shares a day. This trend, however, is reversed for stocks trading 1,100 shares or less a day. From this, it is clear that the specialist plays a more significant role in providing liquidity for inactive securities than for active ones.

Table B-1*

New York Stock Exchange Market Volume vs. Secialist Transaction Participation Rate (Per cent of stock days[a] in each category of market volume falling into each range of specialist transaction participation rate)

Market Volume (Shares)	Specialist Transaction Participation Rate[b]					
	.01 to 16.00%	16.01 to 26.00%	26.01 to 37.00%	37.01 to 50.00%	50.01% and over	Total
10,000 and over	42.5%	18.9%	18.9%	8.0%	1.7%	100%
5,701 to 10,000	28.8	26.7	24.8	15.0	4.7	100
3,901 to 5,700	25.9	23.1	25.7	15.6	9.7	100
2,801 to 3,900	25.8	19.9	23.8	18.9	11.6	100
2,101 to 2,800	24.7	19.1	23.7	18.1	14.4	100
1,501 to 2,100	22.5	19.4	20.7	18.5	18.9	100
1,101 to 1,500	17.7	19.1	22.4	18.8	22.0	100
701 to 1,100	14.4	18.7	19.3	21.5	26.1	100
401 to 700	4.1	26.2	13.7	25.1	30.9	100
10 to 400	0.4	7.9	15.2	25.1	51.4	100

*Source: Report of the Special Study of the Securities Markets of the Securities and Exchange Commission (88th Congress, House Document 95, Part 2, p 459, 1963 (Washington, D.C.: Government Printing Office).

[a]One stock day = a one day obervation on one stock. Data are for three weeks ending January 27, March 24, and June 16, 1961.

[b]Number of specialist transactions as a per cent of the number of market transactions.

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Young Hoon Byun, the youngest son of Mr. Ho Seok Byun and Mrs. Jungkyu Kang, was born in Bongwha, Korea, on February 10, 1954. He married Seunghye Choi in 1983.

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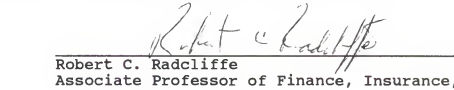
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality as a dissertation for the degree of Doctor of Philosophy

Haim Levy, Chairman
Walter J. Matherly Professor of Finance, Insurance, and Real Estate

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality as a dissertation for the degree of Doctor of Philosophy.



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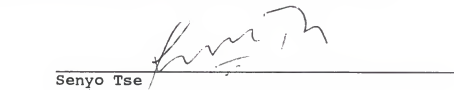

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